

DOE/NASA CONTRACTOR REPORT

DOE/NASA CR-150771

SOLAR CONTROL DESIGN PACKAGE

Prepared from documents provided by

Solar Control Corporation  
5595 Arapahoe Road  
Boulder, Colorado 80302

Under Contract NAS8-32258 with

National Aeronautics and Space Administration  
George C. Marshall Space Flight Center, Alabama 35812

For the U. S. Department of Energy

(NASA-CR-150771) SOLAR CONTROL DESIGN  
PACKAGE (Solar Control Corp., Boulder,  
Colo.) 57 p HC A04/MF A01 CSCI 10A

N78-31535

Unclas  
G3/44 30266

**U.S. Department of Energy**

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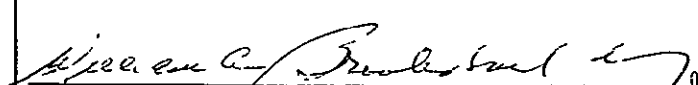
**Solar Energy**

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12. SPONSORING AGENCY NAME AND ADDRESS National Aeronautics and Space Administration Washington, D. C. 20546		13. TYPE OF REPORT & PERIOD COVERED Contractor Report
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15. SUPPLEMENTARY NOTES This work was done under the technical management of Mr. James Hankins, George C. Marshall Space Flight Center, Alabama.		
16. ABSTRACT  This report contains information used in the evaluation of design of Solar Control's solar heating and cooling system controller and the Solarstat. Some of the information includes system performance specifications, design data brochures, and detailed design drawings.  Slight modifications have been made for clarification only.		
17. KEY WORDS		18. DISTRIBUTION STATEMENT Unclassified-Unlimited   WILLIAM A. BROOKSBANK, JR. Mgr, Solar Heating and Cooling Project Office
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## SUBSYSTEM PERFORMANCE SPECIFICATION

Specification No. SHC-3064

Page Date 3-9-77

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### 1.0 INTRODUCTION

This Performance Specification establishes the requirements for the design and performance of the subsystem. It designates the Interim Performance Criteria applicable to the subsystem and defines the deviations.

### 2.0 APPLICABLE DOCUMENTS

#### 2.1 Government Documents

See Appendix F

#### 2.2 Contractor Documents

-Application Note 74-116 for Solar Heating and Cooling, 1974.

-Zia Four Mode Controllers - #75-140 and #75-160, 1975.

-Zia Modular Controllers - #75-170 Series, 1975.

-Zia #75-150 Solar Air Handling Moduls (SAM), 1975.

#### 2.3 Other Documents

-Proceedings of the Solar Heating and Cooling For Buildings

Workshop, Part I: Technical Sessions, March 21 and 22, NSF/RA/N-73-004.

-Solar Heating Handbook For Los Alamos, LA-5967 May 1975.

### 3.0 APPLICATION OF INTERIM PERFORMANCE CRITERIA

The application of each paragraph of the Interim Performance Criteria to the subsystem is provided in the following table, Number 1.

### 4.0 DEVIATIONS FROM INTERIM PERFORMANCE CRITERIA

None

## SUBSYSTEM PERFORMANCE SPECIFICATION

Specification No. SHC-3064

Page Date 3-9-77

Page \_\_\_\_\_ of \_\_\_\_\_

### 5.0 GOVERNMENT FURNISHED PROPERTY

: None

### 6.0 GOVERNMENT DIRECTED REQUIREMENTS

### 7.0 SUBSYSTEM GENERAL SPECIFICATION AND FEATURES

The following            page delineates the general specifications and features of the Series 75-170, Modular-Control Subsystem.

Modular Controller Series 75-170

Table I

Residential subsystems: Interim Performance Criteria Summary

The following Interim Performance Criteria paragraphs are applicable:

- 1.7 Control
  - 1.7.1 Installation and Maintenance
  - 1.7.3 Inhabited Space Temperature
- 2.5 Subsystem Isolation
  - 2.5.1 Shutdown in Multi-Family Housing
- 4.1 Plumbing and Electrical Installation
  - 4.1.2 Electrical Codes
- 4.2 Fail-Safe Controls
  - 4.2.1 System Failure Prevention
- 5.2 Temperature and Pressure Resistance
  - 5.2.1 Thermal Degradation
- 6.1 Accessibility for Maintenance
  - 6.1.1 Access for System Maintenance
  - 6.1.2 Access for System Monitoring
- 6.2 Installation, Operation, and Maintenance Manual
  - 6.2.1 Installation Instructions
  - 6.2.2 Maintenance and Operation Instructions
  - 6.2.3 Maintenance Plan
  - 6.2.4 Replacement Parts
- 6.3 Repair and Service Personnel
  - 6.3.1 Maintenance of H and HC Systems
- 11.3.1 Material Compatibility



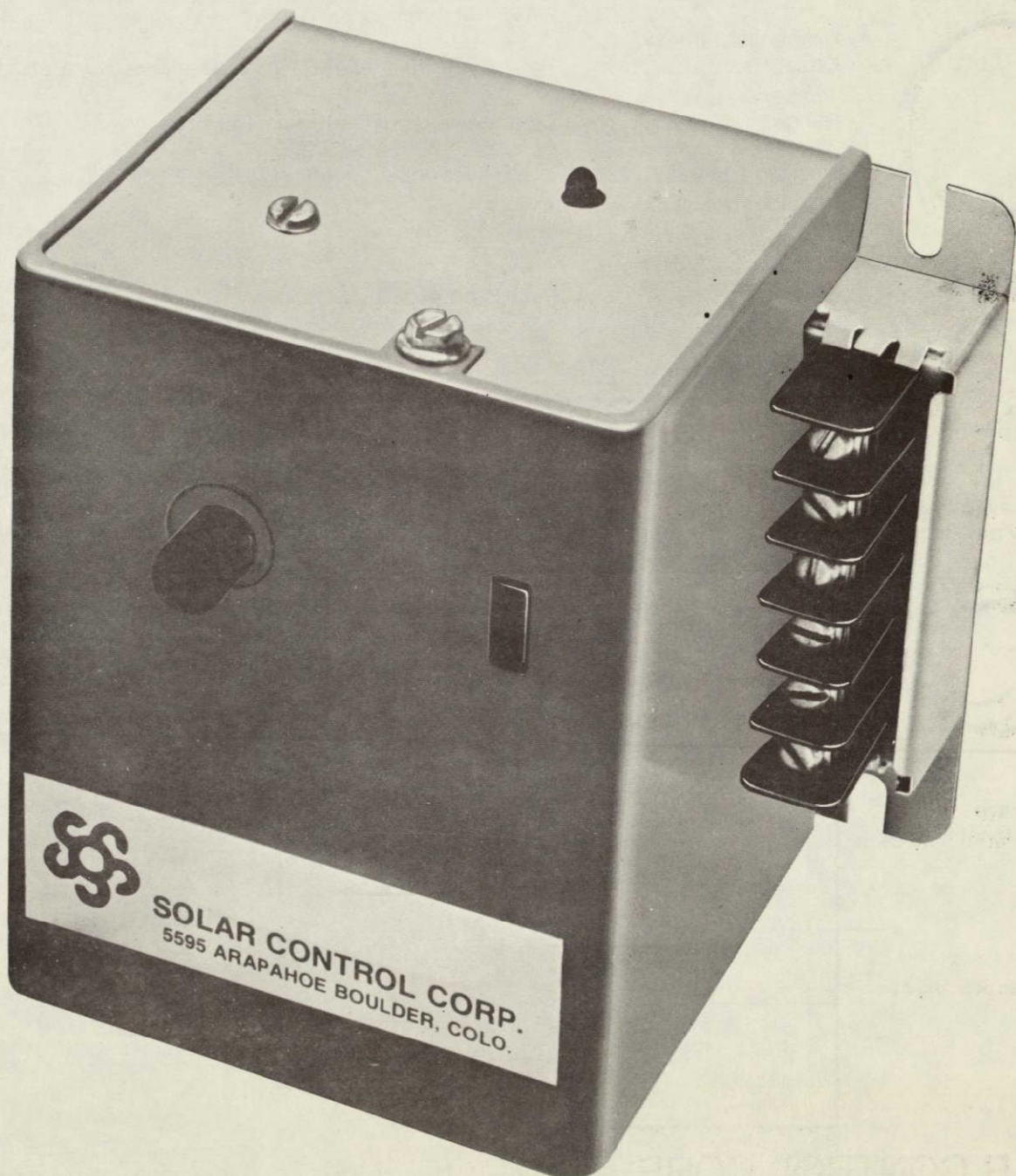
SCC 75-171 Solid State Solar Differential Controller

General Specifications:

1. Input Voltage:	Either 120 VAC $\pm$ 10 V or 24 VAC $\pm$ 4 V
2. Input Power:	3 watts (no-load)
3. Outputs	DPDT (3PDT available)
4. Output Current	10 amp (resistive) at 28 VDC or 120 VAC (higher ratings available)
5. Output Voltage	Either 120 VAC or 24 VAC
6. Sensors	Matched thermistors, $\pm 1^\circ\text{C}$ over range from $0^\circ\text{C}$ to $+100^\circ\text{C}$ in a metal housing with high temperature teflon leads
7. Differential Turnoff Offset	Typically $4^\circ\text{F} \pm 2^\circ$ @ $100^\circ\text{F}$ (can be custom adjusted by a resistor change)
8. Differential Turnon Offset	Typically $20^\circ\text{F} \pm 2^\circ$ @ $100^\circ\text{F}$ (can be custom adjusted by a resistor change)
9. Operating Temperature Range	Controller chassis: $0^\circ\text{F}$ to $140^\circ\text{F}$ Sensors: $-40^\circ\text{F}$ to $300^\circ\text{F}$
10. Tracking Accuracy	$\pm 5^\circ\text{F}$ over entire operating range
11. Isolation Protection	1500 V
12. Size	Basic Module about 4" x 4" x 3½"
13. Weight	Less than 2 lb.
14. Multichannel Priority	24 VAC interconnect logic
15. Mounting	Mount on "J" box or on wall or pump housing
16. Collector freeze protect (differential signal "on" typically; remote signal also available)	At $40^\circ\text{F} \pm 5^\circ$
17. Manual "on" Button	
18. Operating Light	100,000 hr. LED illuminates to indicate operation
19. Distribution Channel and Auxiliary Heater Control	For 75-172, 75-173 configuration
20. Multi-Tank Control	For 75-175 configuration



# SOLID STATE SOLAR HOT WATER CONTROLLER





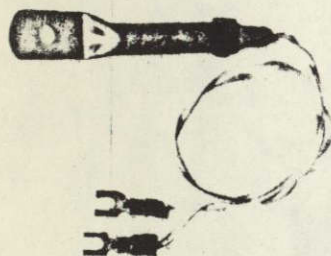
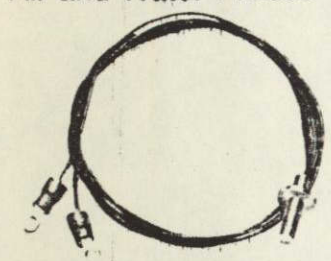
# Model 77-171

## Solid-State Solar Hot Water Controller

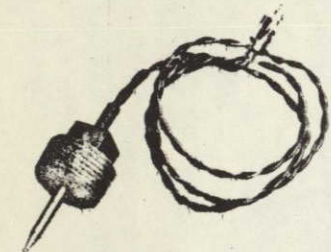
### Description

The model 77-171 is a solid-state differential thermostat capable of fully controlling a solar hot water heating system. The unit is designed for a lifetime of maintenance free service, and incorporates freeze and boil protect circuitry.

### Air and Water Probes



Air probes are available for clamp or screw mounting.

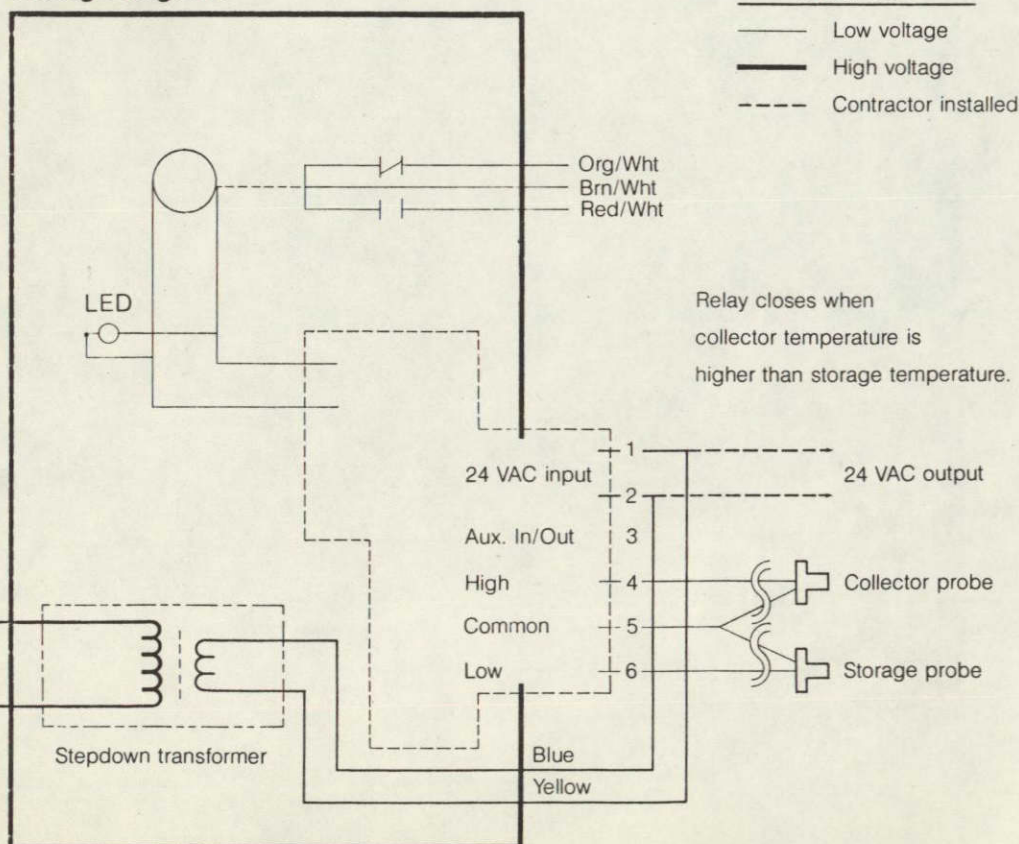


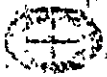
Water probes have 1/2" NPC thread, in lengths from 2 3/4" to 28".

### Specifications

Input Voltage	Either 120 VAC $\pm 10V$ or 24 VAC $\pm 4V$ .
Input Power	3 watts, no load.
Control Relay	SPDT, 10A. (resistive) at 28 VDC or 120 VAC. Higher ratings available.
Output Voltage	Either 120 VAC or 24 VAC.
Sensors	Matched thermistors, ( $\pm 1^\circ C$ over range from $0^\circ C$ to $+100^\circ C$ ) in a metal housing, with high temperature teflon leads.
Differential Turn-off Offset	Typically $4^\circ F \pm 2^\circ$ @ $100^\circ F$ , (can be adjusted by a resistor change).
Differential Turn-on Offset	Typically $20^\circ F \pm 2^\circ$ @ $100^\circ F$ , (can be adjusted by a resistor change).
Temperature Range	Controller chassis: $-40^\circ F$ to $140^\circ F$ Sensors: $-40^\circ F$ to $+300^\circ F$
Tracking Accuracy	$\pm 5^\circ F$ over entire operating range.
Isolation Protection	1500 V
Size	4" $\times$ 4" $\times$ 3 1/2"
Weight	2 lbs.
Mounting	Mounts on 4" $\times$ 4" "J" box.

### Wiring Diagram





CIA ASSOCIATES INC.

BOULDER COLORADO

CODE IDENT NO 52060

SHEET

DOC NO

10 171

DATE

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DR. HENRY GARDNER

171 GARDNER DR. ALB

75-171

PREPARED BY D AUGUSTO DRAWING BREAKDOWN

PAGE 2 OF 2

DATE \_\_\_\_\_ PROJECT 171 CONTROLLER (NASA)

NUMBER 76-999

SIZE	DRAWING NUMBER	DRAWING LEVEL								DOCUMENT TITLE	EXPECTED RELEASE DATE	REMARKS
		1	2	3	4	5	6	7	8			
D	2816-A ✓	X								AT CONTROLLER ASSY	2/23/77	
C	2777-C			X						PWB AT	2/22/77	
C	2801-B		X							PWA AT	2/16/77	
D	2807			X						SILK SCREEN (PWA)	2/16/77	
C	2776-A									SCHEMATIC AT CONTROLLER	12/13/76	
C	2803									WIRING DIAGRAM 171	2/23/77	
	2804									" " 172		
C	2805A									" " 173	2/23/77	
	2806									" " 174		
D	2807 ✓									" " 175		
D	2817 ✓	X								MOD. CHASSIS BOX	2/23/77	
A	2816-LPL									PARTS LIST		
C	2790-A ✓	X								INTERNAL WIRING	3/7/77	
C	2764-B ✓	X								AT CONTROLLER PROBE	12/10/76	
C	2763 ✓	X								PROBE HOUSING	12/4/76	
D	2835 ✓	X								BASE, BOX, 171 CONTROLLER	3/31/77	
A	2839 ✓									AT Test Procedure	4/4/77	
C	2876									Test Fixture	5/24/77	
C	2886 ✓									Relay Assembly	6/8/77	
Prepared for:												
POLAR CONTROL CORP.												
5595 ARAPAHOE ROAD												
BOULDER COLORADO												

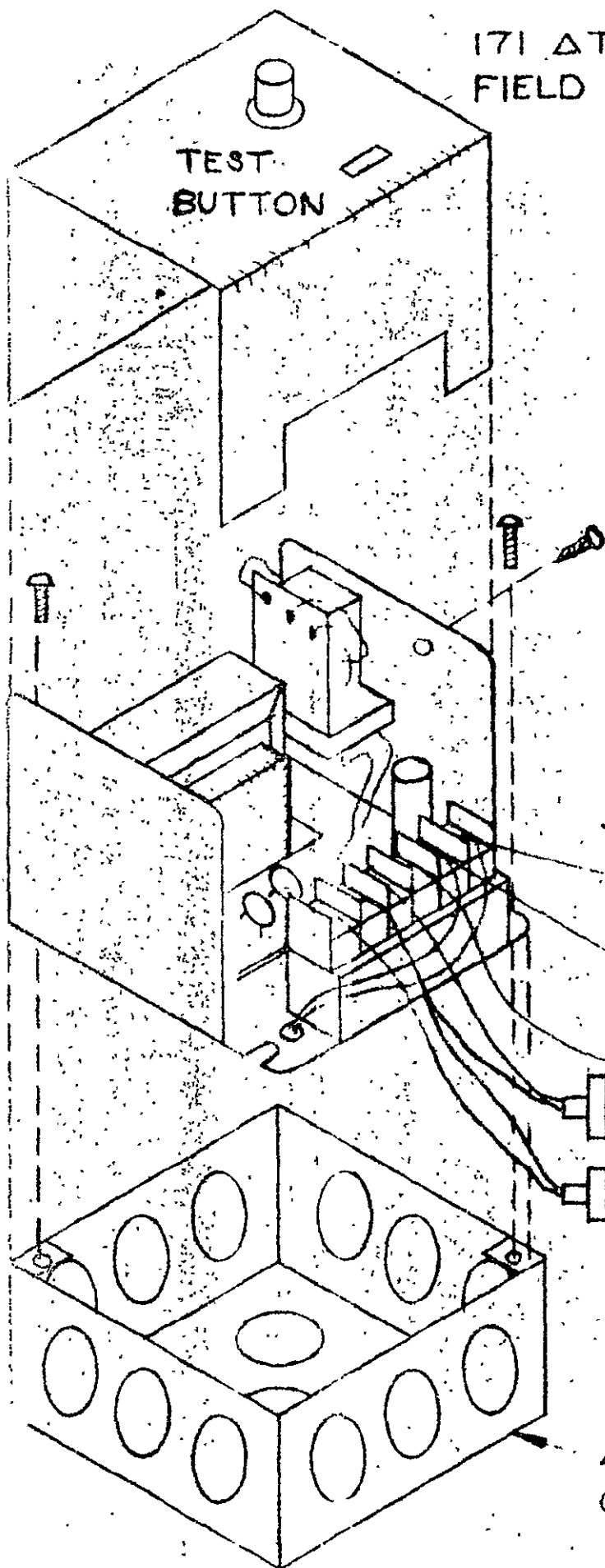
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DATE	DESCRIPTION	AMOUNT	DATE	APPROVED

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ZIA ASSOCIATES INC. COLORADO	
171 AT CONTROLLER	
Installation	
2593	

# 171 AT CONTROLLER FIELD INSTALLATION DIAGRAM



## RELAY WIRES

NC	RED/BLACK
COMMON	RED
NO	RED/WHITE
NC	BROWN/BLACK
COMMON	BROWN
NO	BROWN/WHITE
NC	ORG/BLACK
COMMON	ORG
NO	ORG/WHITE

TERM'S

1 BLU

2 YEL

FROM 24V AC  
TRANSFORMER

3 AUX, OUTPUT

4 COLLECTOR PROBE

5 COMMON

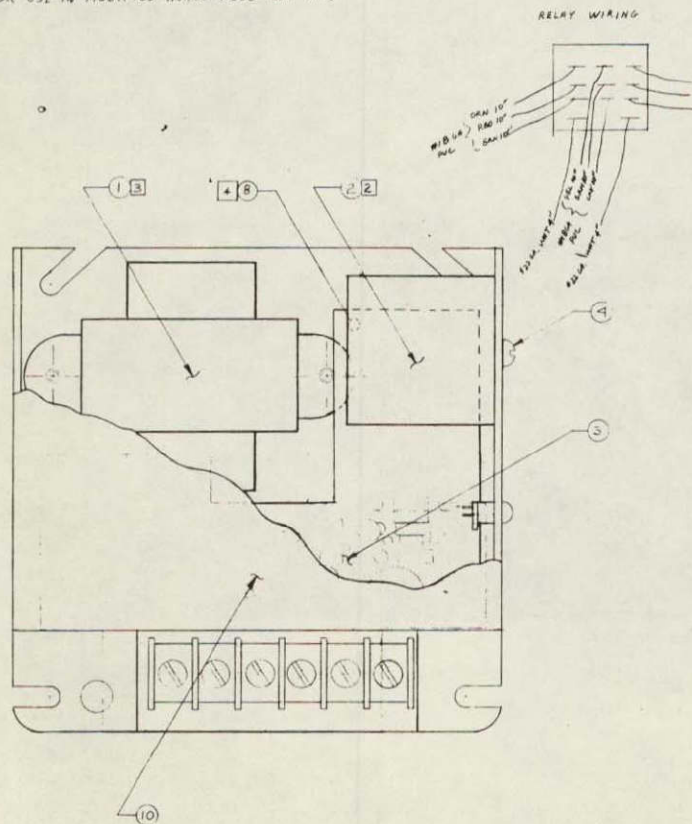
6 STORAGE PROBE

4" X 4"  
OUTLET BOX



GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

- 1 SUPPLIED WITH ITEMS
- 2 OPTION-4 REPLACE RELAY #5XB20 (ITEM 2) WITH RELAY #5XB17
- 3 OPTION-5 TRANSFORMER INCLUDED IN ASSY.
- 4 FOR USE IN MODIFIED HONREF WELL BOX ONLY



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WIRE:	20"	18 GA.	PVC	600 V	DRANGE
	"	"	"	"	RED
	"	"	"	"	BAN
	"	"	"	"	VELA
	"	"	"	"	GAN
	"	"	"	"	GAFF
	"	"	"	"	WHT

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION (REFER TO DRAWING FOR DIMS)	MATERIAL SPECIFICATION
1	10	1	COVER			
2	9		NUT, HEX	#6-32		
3	8		STAND OFF		H. H. SMITH #297	
4	7		B. H. SCREW	#6-32-1		
5	6	AD44ABS	POP RIVET			USM
6	5	2B17	CHASSIS BOX, MOD			
7	4		B. H. SCREW	#6-32-3/8		
8	3	2801	171AT PWA			DAYTON
9	2	5XB20	RELAY 2			DAYTON
10	1	AT20AH23	TRANSFORMER 3			HONREF WELL

<b>REVISION</b> 1 SHEET NO 501 76 474		<b>CONTRACT NO</b> UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES .005 .010 .015 .020 .030 .040 .050 .060 .070 .080 .090 .100 .125 .150 .175 .200 .250 .300 .350 .400 .450 .500 .600 .700 .800 .900 1.000 1.125 1.250 1.500 1.750 2.000 2.500 3.000 3.500 4.000 4.500 5.000 6.000 7.000 8.000 9.000 10.000 BREAK ALL SHARP EDGES .001/.015 UNLESS OTHERWISE SPECIFIED SHOP STANDARDS THROUGH PER IN 28 SURFACE FINISH 125 EXCEPT AS NOTED		<b>APPROVED</b> DATE 1/1/77 DESIGNED GROUP ENG CHECKED PREPARED FOR POLAR CONTROL CORP. 2000 ARAPAHOE ROAD COLORADO		<b>PARTS LIST</b> ZIA ASSOCIATES INC. BOULDER COLORADO 171 AT CONTROLLER TOP ASSY SIZE CODE IDENT NO 2816 A SCALE 2/1 1/1	
--	--	---	--	---	--	---	--

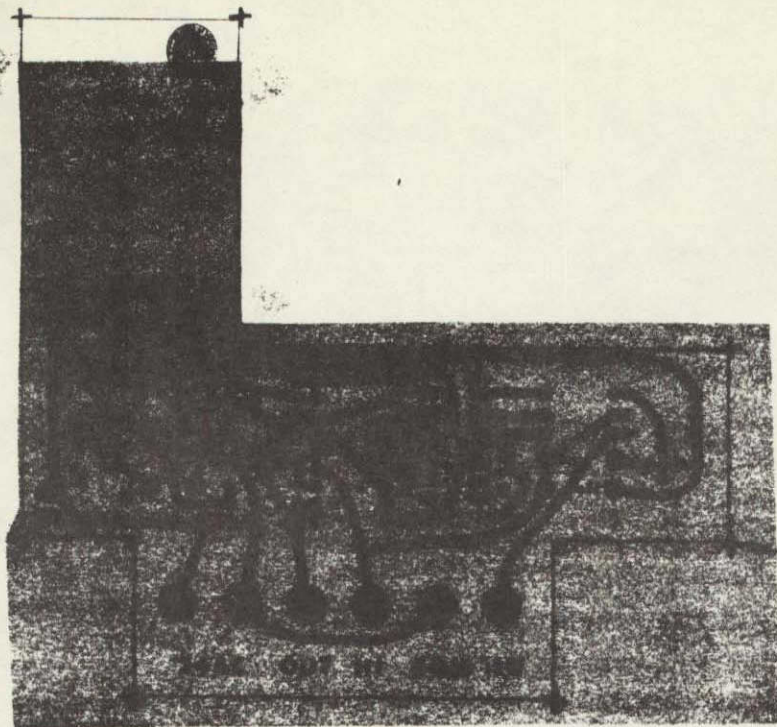
2816 A



GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

1. MATERIAL: 062 GLASS EPOXY 2 OZ SINGLE SIDE
2. TIN LEAD PER MIL-STD-275
3. FOIL SIDE SHOWN
4. SILKSCREEN PER ARTWORK 2800

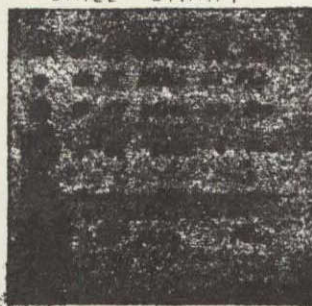
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LTR	DESCRIPTION	DATE	APPROVED
B	CHANGED TERMINAL DESCRIPTIONS	2/22/77	DL
C	LENGTHENED BOARD ADDED PASS #3 AND #4	4/8/77	DL
D	Shear Marks Moved Slightly Inward Changed Mounting hole from 5/16" to #28	4/27/77	D.S.



SHEAR MARK TYP.  
10 P.L.C.

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DRILL CHART



REVISION	SHEET NO	PART NO	NEXT ASSY	USED ON	APPLICATION
1	2801	171			

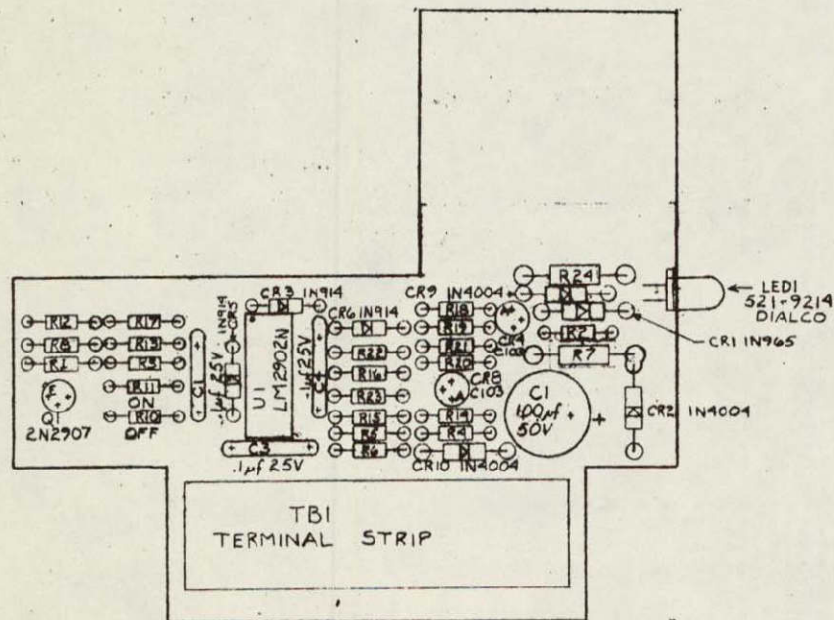
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QTY PER ASSY	CONTRACT NO		PARTS LIST		EVEN DASH NUMBERED PARTS OPPOSITE	
UNLESS OTHERWISE SPECIFIED			APPROVED	DATE	ZIA ASSOCIATES INC.	
DIMENSIONS ARE IN INCHES TOLERANCES			PREP BY	4/8/77	BOULDER COLORADO	
XX = .02	XXX = .010	X* = .1"	DESIGNER	4/2/77	171 AT CONTROLLER	
BREAK ALL SHARP EDGES 005/015 MIL-STD 12, 15			GROUP ENG		PWB DRILL CHART	
USASI Y3216, B461, Y145			CHECKED			
SHOP STANDARDS 2060						
THREADS PER H-28						
SURFACE FINISH L28 EXCEPT AS NOTED						
SIZE		CODE IDENT NO	REV			
C	52060	2777	D			
SCALE 2/1		WT	SHEET 1 OF 1			

2777 D



GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

1. TO DISABLE FASER PROTECT: CLIP OUT CR6
2. TO DISABLE BNL PROTECT: CLIP OUT CR5



REF DES	DESCRIPTION	QTY
R2	330K 5% 1/4W	1
R18,17	10K 5% 1/4W	2
R12,R19	1K 5% 1/4W	2
R3,13,14,23	33K 5% 1/4W	5
R22	10M 5% 1/4W	1
R5	2.05 1% 1/4W	1
R14,8	10K 1% 1/4W	3
R10	105K 1% 1/4W	1
R11	19.1K 1% 1/4W	1
R15	88.7K 1% 1/4W	1
R7	820K 5% 1/2W	1
C1	100µF 150V ALUM	1
C2,3,4	.1µF 125V DISC	3
CR1	IN965	1
CR2,9	IN4004	2
CR3,5,6	IN914	3
CR4	SCR GE-C103	1
Q1	2N2907	1
U1	LM2902N	1
TBI	TERMINAL STRIP	1
R14	6.98K 1% 1/4W	1

#### OPTION -1 (LED)

LED-1	DIALCO 521-9214	1
R24	1K 5% 1/2W	1

#### OPTION -2 (AUX FREEZE OUTPUT)

R20	1K 5% 1/4W	1
R21	10K 5% 1/4W	1
CR8	SCR GE-C103	1
CR10	IN4004	1

#### OPTION -3 (15 OPTIONS-1 & -2 TOGETHER)

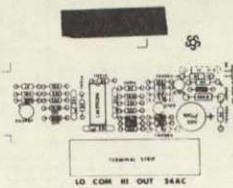
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CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				PREP BY	2/4/77	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES				DESIGNER			
TOLERANCES				GROUP ENG			
XX .XXX X"				CHECKED			
.02 .010 .1"				Prepared for			
BREAK ALL SHARP EDGES 005/015				SOLAR CONTROL CORP.			
MIL-STD 12.15				5505 ARAPAHO ROAD			
USASI Y32.16, 946.1, Y14.5				BOULDER COLORADO			
SHOP STANDARDS 2060				SCALE 2/1 WT			
THREADS PER N-28				SHEET 1 OF 1			
SURFACE FINISH 125 EXCEPT AS NOTED							
REVISION		PART NO		CODE IDENT NO		SIZE	
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MULTIPLE SHEETS		NEXT ASS'Y USED ON		D			
REVISION STATUS		APPLICATION					

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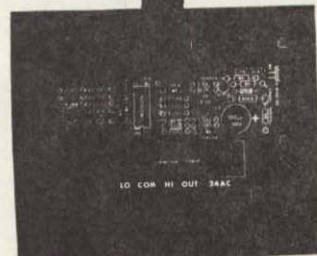
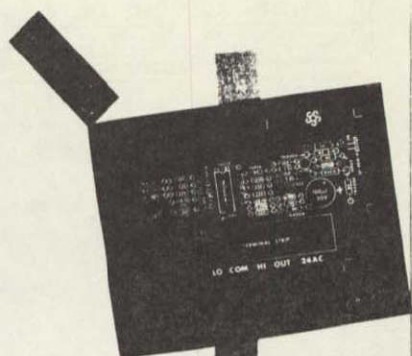
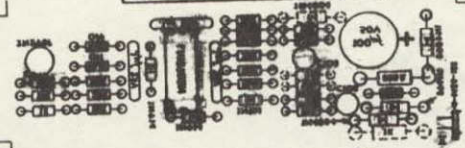
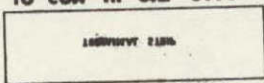
11. 11. 11



2800  
211

51  
5800 C.

10 COM HI OUT 34AC



ITEM		QUANTITY	UNIT	REMARKS
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3	CONTRACT NO.			
4	UNLESS OTHERWISE SPECIFIED			
5	CONTRACT NO.			
6	UNLESS OTHERWISE SPECIFIED			
7	CONTRACT NO.			
8	UNLESS OTHERWISE SPECIFIED			
9	CONTRACT NO.			
10	UNLESS OTHERWISE SPECIFIED			

REVISION	SHEET NO.	DATE	APPROVED	DATE
1	1	7-1-74		

MULTIPLE SHEETS	REVISION STATUS	APPLICATION

PARTS LIST	
1	CONTRACT NO.
2	UNLESS OTHERWISE SPECIFIED
3	CONTRACT NO.
4	UNLESS OTHERWISE SPECIFIED
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10	UNLESS OTHERWISE SPECIFIED

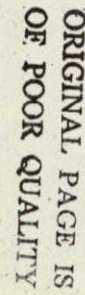
**ZIA ASSOCIATES INC**  
BOULDER, CO 80501

171 AT CON  
PWA SILK  
2800

D 52060



10	
6	ARMY AIRBORNE DIVISION
8	ARMY AIRBORNE DIVISION

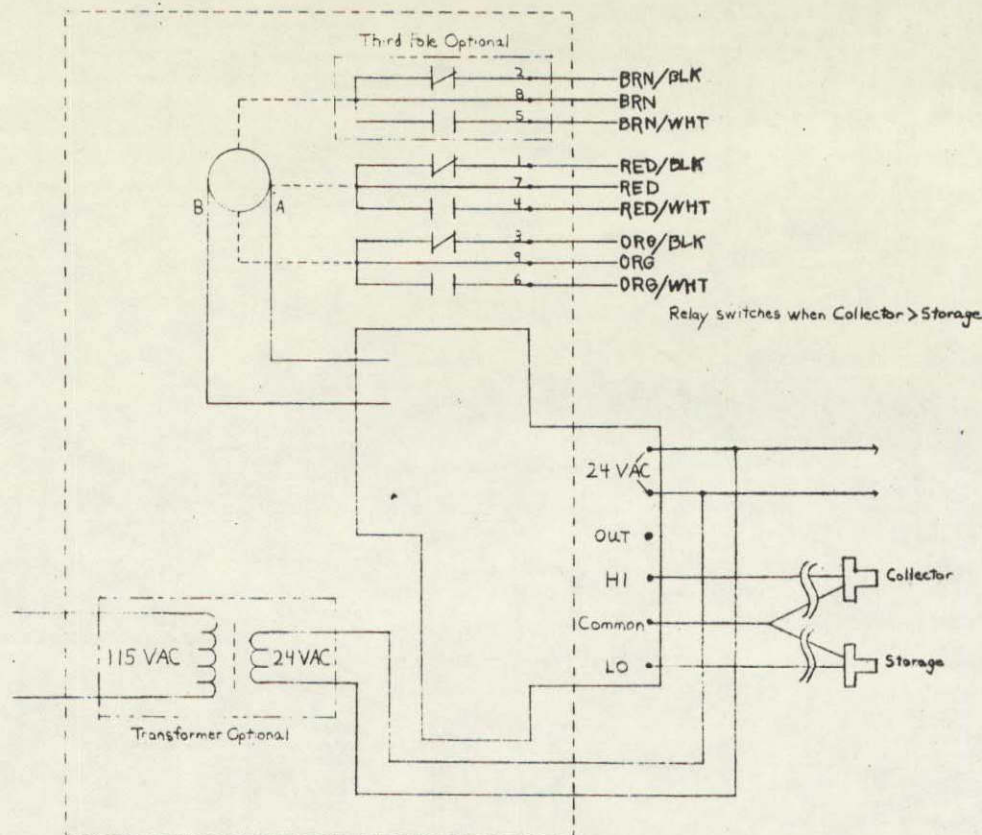


100°F	=	2.498 K
119°F	=	10.35 K
100°F	=	16.86 K
32°F	=	80.176 K

2.28



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED

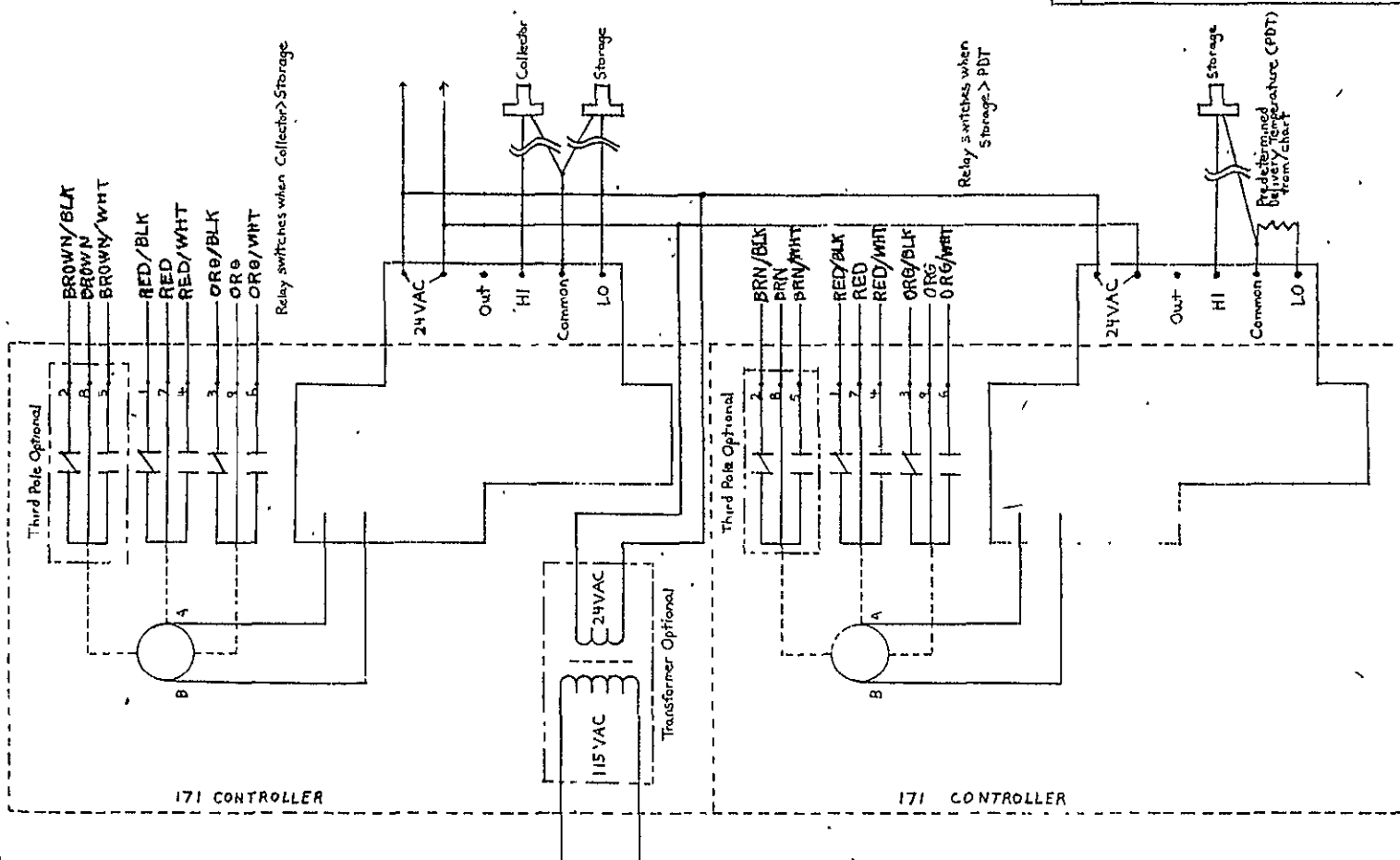


ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	REVISIONS
QTY PER ASSY						
CONTRACT NO						
UNLESS OTHERWISE SPECIFIED						
DIMENSIONS ARE IN INCHES						
TOLERANCES						
XX .02						
XXX .010						
X* .015						
BREAK ALL SHARP EDGES .006/.015						
MIL-STD 12, 15						
USASI Y32.16, 944.1, Y14.5						
SHOP STANDARDS 2090						
THREADS PER N-38						
SURFACE FINISH 125						
EXCEPT AS NOTED						
APPROVED						
DATE						
DESIGNER						
GROUP ENG						
CHECKED						
Prepared for						
SOLAR CONTROL CORP.						
8695 ARAPAHOE ROAD						
FOURTEEN						
COLORADO						
ZIA ASSOCIATES INC.						
BOULDER						
COLORADO						
171 Wiring Diagram						
SIZE						
CODE IDENT NO						
C 52060						
2803						

REVISION	
SHEET NO	76-934
MULTIPLE SHEETS	
REVISION STATUS	
PART NO	EXT ASSY
USED ON	
APPLICATION	

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LT#	DESCRIPTION	DATE	APPROVED
A	ADDED "171 CONTROLLER" DESIGNATIONS	3/30/77	Sal



QTY PER ASST	ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE INFORMATION ELEC DWG	MATERIAL SPECIFICATION
000 DASH NUMBERED PARTS SHOWN							
PARTS LIST							
EVEN DASH NUMBERED PARTS OPPOSITE							

REVISION		CONTRACT NO		APPROVED		DATE	
1		76-934		J. Dutton		2/23/77	
SHEET NO		UNLESS OTHERWISE SPECIFIED		DESIGNER			
MULTIPLE SHEETS		DIMENSIONS ARE IN INCHES		GROUP ENG		3/30/77	
REVISION STATUS		TOLERANCES		CHECKED			
		XX ± .02		Prepared for			
		X ± .010		SOLAR CONTROL CORP.		SIZE	
		X ± .015		5575 ADAPAHOE ROAD		CODE IDENT NO	
		X ± .020		BOULDER		C 52060	
		X ± .030		COLORADO		2805	
		X ± .040		SCALE NONE		WT	
		X ± .050				A	

**ZIA ASSOCIATES, INC.**  
BOULDER COLORADO

173 Wiring Diagram

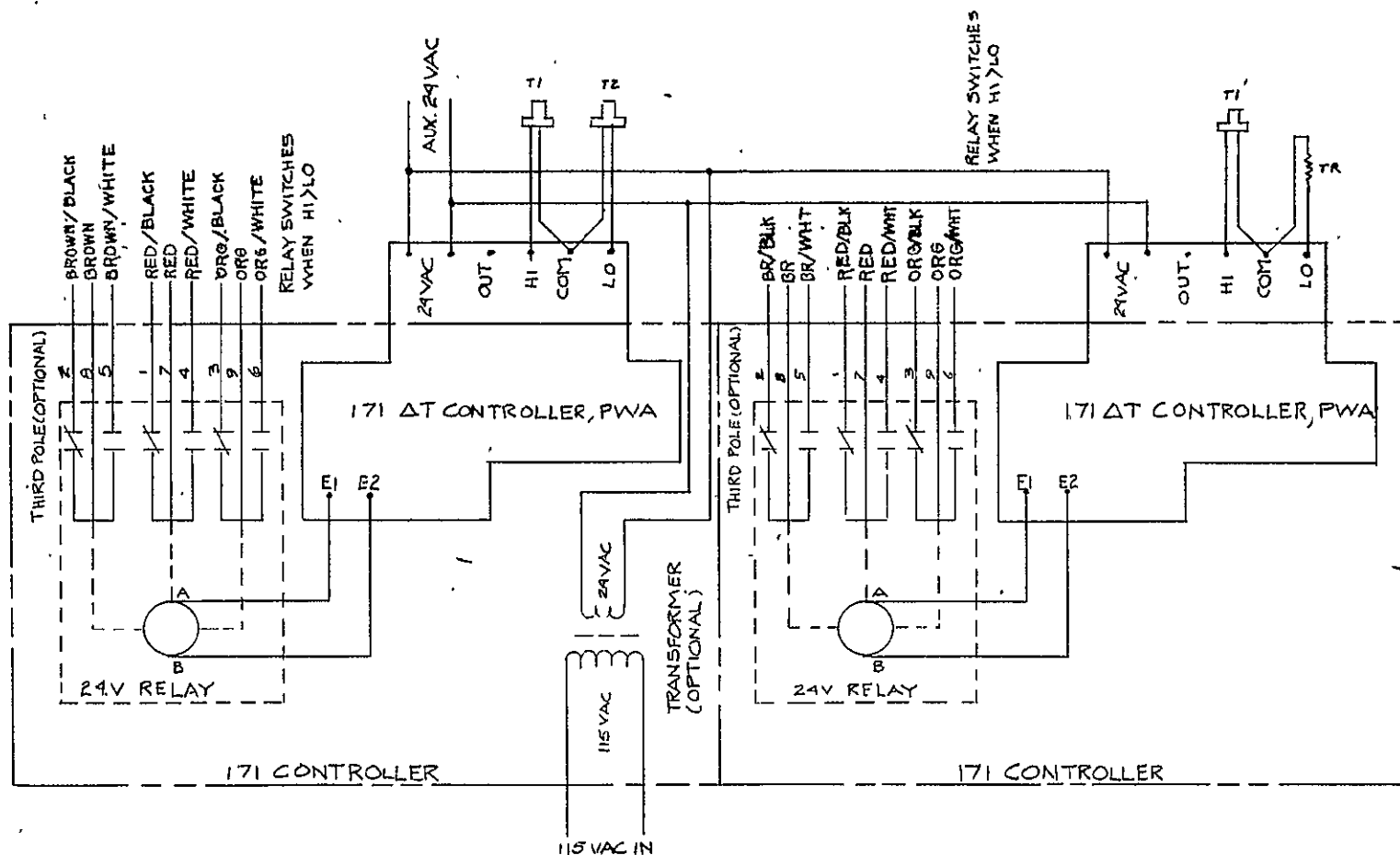
SOLAR CONTROL CORP.  
5575 ADAPAHOE ROAD  
BOULDER COLORADO

02

REVISION 216421

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTB	DESCRIPTION	DATE	APPROVED



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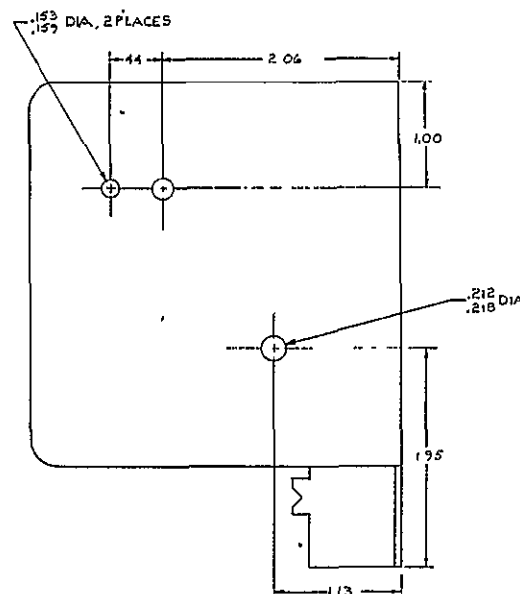
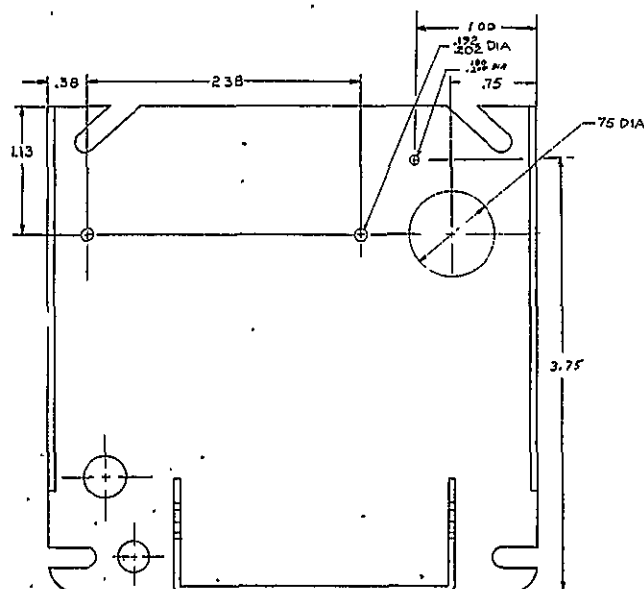
4082

QTY PER ASSY	ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE DESIGNATION ELEC PWR	MATERIAL SPECIFICATION
CONTRACT NO.				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				DESIGNER		BOULDER COLORADO	
DIMENSIONS ARE IN INCHES TOLERANCES XX ± .02 XXX ± .010 X* ± .1"				GROUP ENG		175 WIRING DIAGRAM 171 CONTROLLER	
BREAK ALL SHARP EDGES 005/015 MIL STD 32, 35 USASI Y32 15 844 1, V14 5 SHOP STANDARDS 2060 THREADS PER H 28 SURFACE FINISH 125 EXCEPT AS NOTED				CHECKED		76-934	
PART NO				PREPARED FOR:		SOLAR CONTROL CORP.	
NEXT ASS'Y				5595 ARAPAHOE ROAD		BOULDER COLORADO	
USED ON				SIZE C	CODE IDENT NO 52060	2807	REV NC
APPLICATION				SCALE NONE	WT	SHEET 1 OF 1	

REVISION	SHEET NO	PART NO	NEXT ASS'Y	USED ON
1	1	76-934		

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

REVISIONS		
NO.	DESCRIPTION	DATE
A	CH	1/1/76
B	CHANGE OF DIM 1.2	1/1/76
C	CHANGE LOCATION OF .212 DIA	1/1/76



ITEM NO.		CODE POINT	PART NO.	DESCRIPTION	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
1				MOD CHASSIS BOX			
PARTS LIST							
CONTRACT NO.				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				DESIGNED BY	DATE	COLORADO	
DIMENSIONS ARE IN INCHES				GROUP	DATE	171 CONTROLLER	
TOLERANCES				GROUP	DATE	MODIFIED	
.0005				GROUP	DATE	CHASSIS BOX	
.001				GROUP	DATE		
.002				GROUP	DATE		
.005				GROUP	DATE		
.010				GROUP	DATE		
.015				GROUP	DATE		
.020				GROUP	DATE		
.030				GROUP	DATE		
.040				GROUP	DATE		
.050				GROUP	DATE		
.060				GROUP	DATE		
.070				GROUP	DATE		
.080				GROUP	DATE		
.090				GROUP	DATE		
.100				GROUP	DATE		
.120				GROUP	DATE		
.150				GROUP	DATE		
.200				GROUP	DATE		
.250				GROUP	DATE		
.300				GROUP	DATE		
.350				GROUP	DATE		
.400				GROUP	DATE		
.450				GROUP	DATE		
.500				GROUP	DATE		
.550				GROUP	DATE		
.600				GROUP	DATE		
.650				GROUP	DATE		
.700				GROUP	DATE		
.750				GROUP	DATE		
.800				GROUP	DATE		
.850				GROUP	DATE		
.900				GROUP	DATE		
.950				GROUP	DATE		
1.000				GROUP	DATE		
1.100				GROUP	DATE		
1.200				GROUP	DATE		
1.300				GROUP	DATE		
1.400				GROUP	DATE		
1.500				GROUP	DATE		
1.600				GROUP	DATE		
1.700				GROUP	DATE		
1.800				GROUP	DATE		
1.900				GROUP	DATE		
2.000				GROUP	DATE		
2.100				GROUP	DATE		
2.200				GROUP	DATE		
2.300				GROUP	DATE		
2.400				GROUP	DATE		
2.500				GROUP	DATE		
2.600				GROUP	DATE		
2.700				GROUP	DATE		
2.800				GROUP	DATE		
2.900				GROUP	DATE		
3.000				GROUP	DATE		
3.100				GROUP	DATE		
3.200				GROUP	DATE		
3.300				GROUP	DATE		
3.400				GROUP	DATE		
3.500				GROUP	DATE		
3.600				GROUP	DATE		
3.700				GROUP	DATE		
3.800				GROUP	DATE		
3.900				GROUP	DATE		
4.000				GROUP	DATE		
4.100				GROUP	DATE		
4.200				GROUP	DATE		
4.300				GROUP	DATE		
4.400				GROUP	DATE		
4.500				GROUP	DATE		
4.600				GROUP	DATE		
4.700				GROUP	DATE		
4.800				GROUP	DATE		
4.900				GROUP	DATE		
5.000				GROUP	DATE		
5.100				GROUP	DATE		
5.200				GROUP	DATE		
5.300				GROUP	DATE		
5.400				GROUP	DATE		
5.500				GROUP	DATE		
5.600				GROUP	DATE		
5.700				GROUP	DATE		
5.800				GROUP	DATE		
5.900				GROUP	DATE		
6.000				GROUP	DATE		
6.100				GROUP	DATE		
6.200				GROUP	DATE		
6.300				GROUP	DATE		
6.400				GROUP	DATE		
6.500				GROUP	DATE		
6.600				GROUP	DATE		
6.700				GROUP	DATE		
6.800				GROUP	DATE		
6.900				GROUP	DATE		
7.000				GROUP	DATE		
7.100				GROUP	DATE		
7.200				GROUP	DATE		
7.300				GROUP	DATE		
7.400				GROUP	DATE		
7.500				GROUP	DATE		
7.600				GROUP	DATE		
7.700				GROUP	DATE		
7.800				GROUP	DATE		
7.900				GROUP	DATE		
8.000				GROUP	DATE		
8.100				GROUP	DATE		
8.200				GROUP	DATE		
8.300				GROUP	DATE		
8.400				GROUP	DATE		
8.500				GROUP	DATE		
8.600				GROUP	DATE		
8.700				GROUP	DATE		
8.800				GROUP	DATE		
8.900				GROUP	DATE		
9.000				GROUP	DATE		
9.100				GROUP	DATE		
9.200				GROUP	DATE		
9.300				GROUP	DATE		
9.400				GROUP	DATE		
9.500				GROUP	DATE		
9.600				GROUP	DATE		
9.700				GROUP	DATE		
9.800				GROUP	DATE		
9.900				GROUP	DATE		
10.000				GROUP	DATE		




APPLICATION			REVISIONS			
PART NO	TEXT ASSY	USED ON	LTR	DESCRIPTION	DATE	APPROVED
			B.	CHANGED FORECAST & ADDED	1/14/77	SA
			C	ADDED WIRE	3/14/77	SA
			D	RIA WAS 15 6.98K 150	4/14/77	SA
			E	R19, 20 were 47 K	4/27/77	D. S.
			F	REMOVED ON NEW FORM	9/20/77	SA

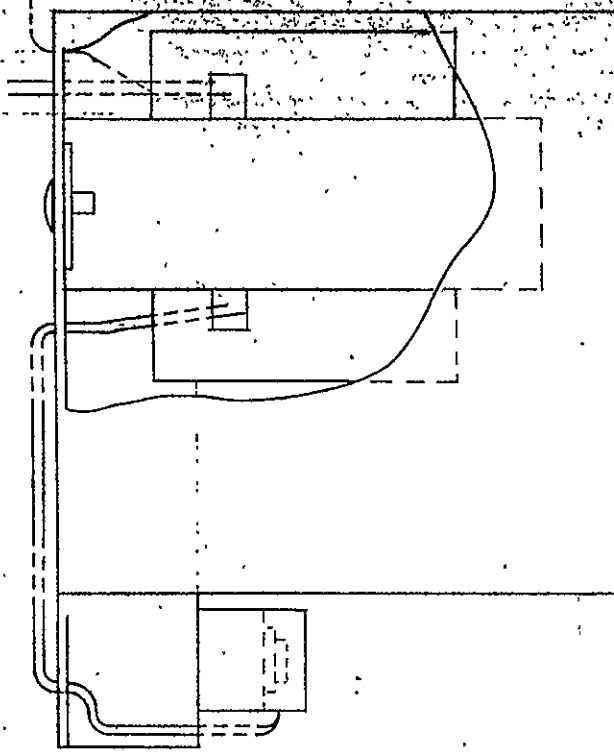
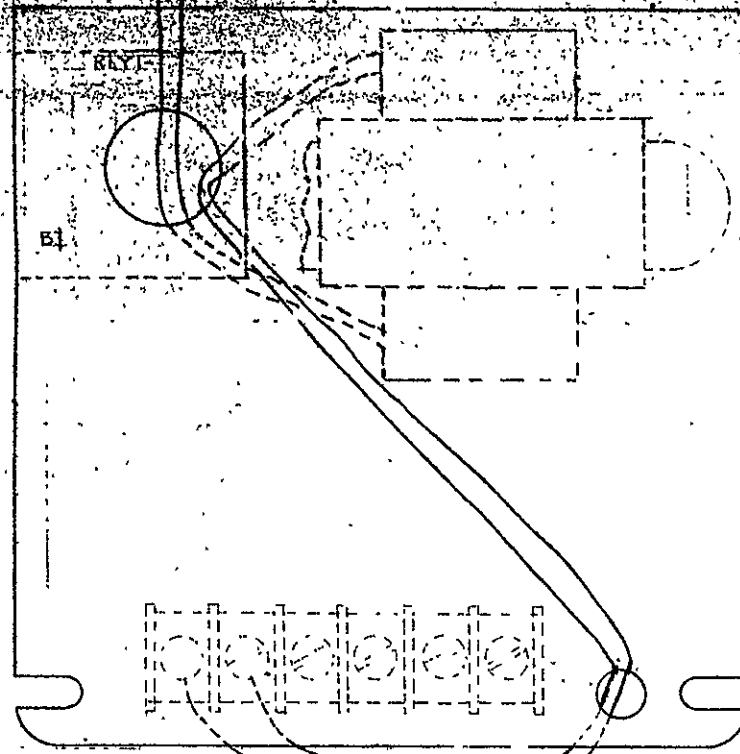
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Prepared for:

SOLAR CONTROL CORP.

5595 ARAPAHOE ROAD  
BOULDER COLORADO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES		RELIABILITY	 <b>ZIA ASSOCIATES INC.</b> BOULDER COLORADO
JXX ±	JXX ±.010	X° ±1°	
CONTRACT NO		DESIGNER	
		CHECKED	
		PREP BY	171
			<b>PARTS LIST</b>
EMC			SIZE
WEIGHTS			CODE IDENT NO
STRESS			2816-PL/E
THERMAL			SCALE
			NA
			SHEET 1/5



FROM	TO	LUG
RLY1-A	PWA-E1	---
RLY1-B	PWA-E2	---
RLY1-1	9" RED/BLK LEAD	---
RLY1-2	9" OR/BLK LEAD	---
RLY1-3	9" BR/BLK LEAD	---
RLY1-4	9" RED/WH LEAD	---
RLY1-5	9" OR/WH LEAD	---
RLY1-6	9" BR/WH LEAD	---
RLY1-7	9" RED LEAD	---
RLY1-8	9" ORANGE LEAD	---
RLY1-9	9" BR LEAD	---
T1-BLUE	AC TERMINAL	SPADE
T2-YELLOW	AC TERMINAL	SPADE
T3-BLACK	---	---
T4-WHITE	---	---

REVISION	SHEET NO
1	171
MULTIPLE SHEETS REVISION STATUS	

PART NO	NEXT ASSY	USED ON
APPLICATION		

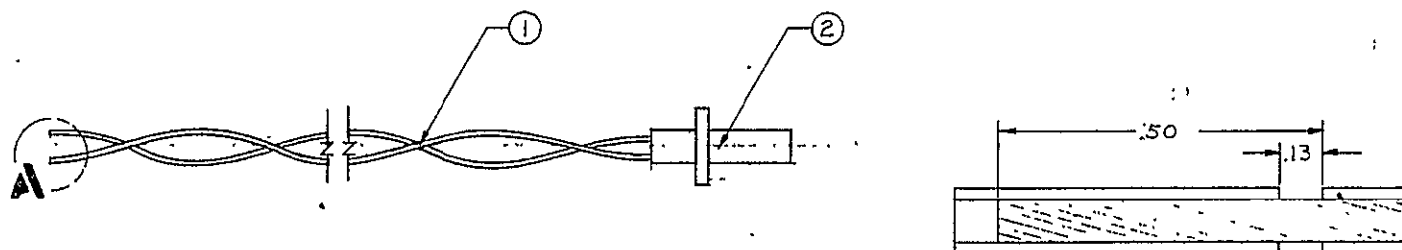
ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION <small>REFERENCE DIMENSIONS ELSE IND</small>	MATERIAL SPECIFICATION
QTY PER ASSY						
QND DASH NUMBERED PARTS SHOWN						
PARTS LIST						
EVEN DASH NUMBERED PARTS OPPOSITE						
CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED			PREP BY <i>Savage, J.W.</i>	9/7/77	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES			DESIGNER		171 AT CONTROLLER	
TOLERANCES			GROUP ENG		INTERNAL WIRING	
XX ± .02			CHECKED			
X ± .010			Prepared for:			
X ± .015						
BREAK ALL SHARP EDGES			SOLAR CONTROL CORP.			
MIN. STD 12, 15			5595 ARAPAHOE ROAD			
USASI Y32.16, 84.1, 714.5			BOULDER COLORADO			
SHOP STANDARDS 2290			SIZE CODE IDENT NO			
THREADS PER INCH			C 52060			
SURFACE FINISH 125			2790			
CHECKY AS NOTED			A			
			SCALE 2/1			
			SHEET 1 OF 1			

2790 A

GENERAL NOTES, UNLESS OTHERWISE SPECIFIED.

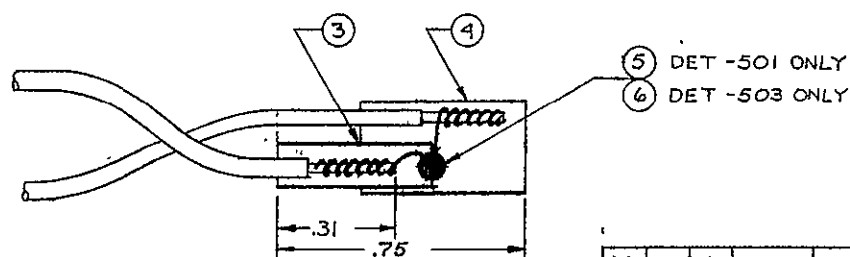
- 1 FENWAL ELECTRONICS FRAMINGHAM, MASS.
- 2 POT. PROBE INTO HOUSING WITH CASTALL 301 RESIN. CURE WITH RT7 CATALYST AT 25°C FOR 24 HRS.

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD DET-503	3/1/72	Sam J.W.
B	ADD DESCRIPTION TO DETAIL A ADD NOTE 2.	3/30/72	pd



DETAIL A  
PRE-STRIP DIM TYP.

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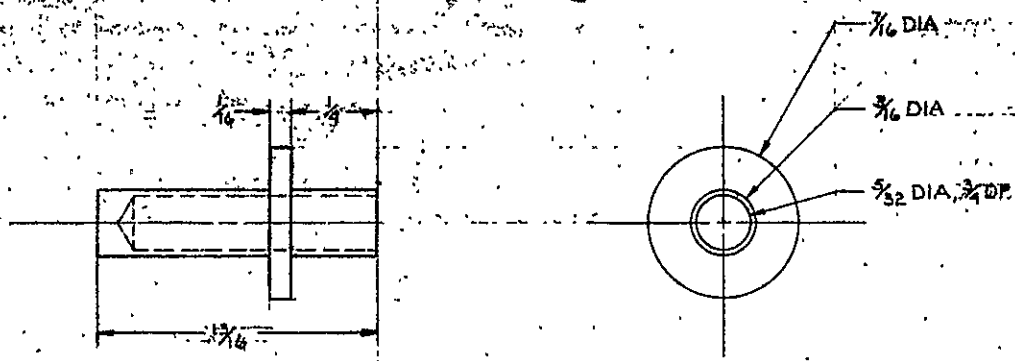


THERMISTOR DETAIL

1	-	6	UUT-35-J1	THERMISTOR			
-	1	5	UUT-43-J1	THERMISTOR			
1	1	4		HEAT SHRINK	3/16 X 5/8		
1	1	3		HEAT SHRINK	3/32 X 3/8		
1	1	2	2763-1	HOUSING			
1	1	1		TWISTED PAIR TEFLON INSUL WIRE	22GAX24"		
503	501	ITEM NO.	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE STANDARD ELEC SPEC

CONTRACT NO		APPROVED		DATE	
UNLESS OTHERWISE SPECIFIED		PREP BY Sam J.W.		3/1/72	
DIMENSIONS ARE IN INCHES TOLERANCES XX ± .02 XXX ± .010 X* ± .1"		DESIGNER			
BREAK ALL SHARP EDGES 905/015 MIL-STD 12.15 USASI Y32.16 846.1, Y14.5 SHOP STANDARDS 2040 THREADS PER UN-28 SURFACE FINISH 125 EXCEPT AS NOTED		GROUP ENG		3/2/72	
REVISION 503		CHECKED			
SHEET NO 501		Prepared for:			
MULTIPLE SHEETS REVISION STATUS		SOLAR CONTROL CORP.		SIZE C	
APPLICATION		5573 A-SPANOS ROAD COLORADO		CODE IDENT NO 52060	
				2764	
				B	
				SHEET 1 OF 1	

2764 B



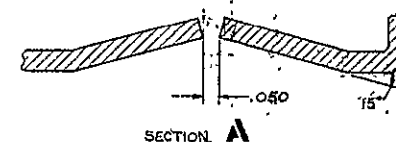
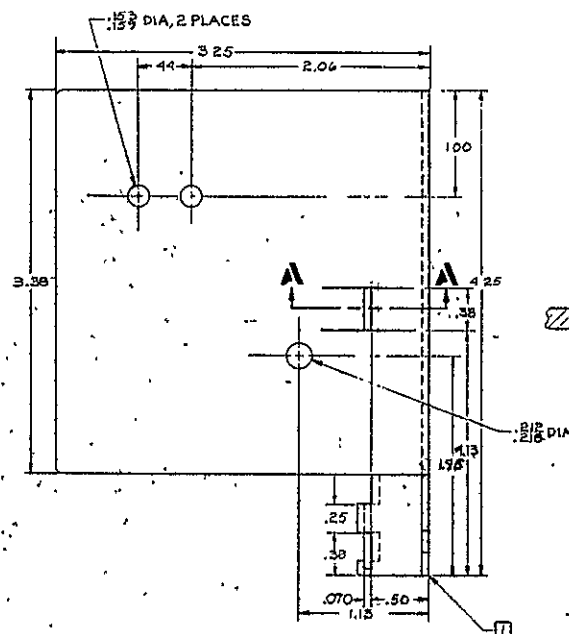
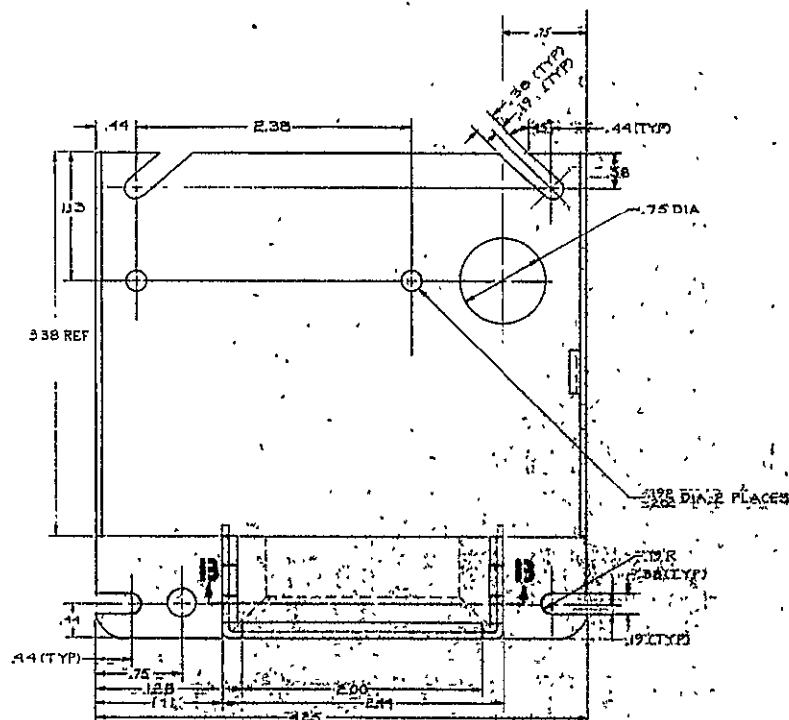
CONTRACT NO.		APPROVED		DATE	
UNLESS OTHERWISE SPECIFIED		PREP BY: <i>[Signature]</i>		12/3/76	
DIMENSIONS ARE IN INCHES TOLERANCES .XXX .X" .X" = .010 = .1" = .1"		CHECKED			
BREAK ALL SHARP EDGES .005/.015 SH. STD 12, 15 QPLAS 152 14, 346.2, 114.8 SHOP STANDARDS 2046 THREADS PER N 78 SURFACE FINISH 125 EXCEPT AS NOTED ✓		Prepared for:			
SOLAR CONTROL CORP.		5555 JEFFERSON ROAD		BOULDER, COLORADO	
ZIA ASSOCIATES, INC.		BOULDER, COLORADO			
PROBE HOUSING		SIZE		CODE IDENT NO	
		C		52060	
		SCALE 2/1		SHEET 1 OF 1	

REVISION		SHEET NO	
1		12764 PROBE	
PART NO	NEXT ASSY	USED ON	
APPLICATION			

1-77912 DIMENSION

7 SO FLANGE BEND FROM MAIN BODY OR MAKE SEPARATELY WITH FLANGES AND SPOT WELD ON.

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DATE	12/1/47	DATE	APPROVED

CONSISTS OF:

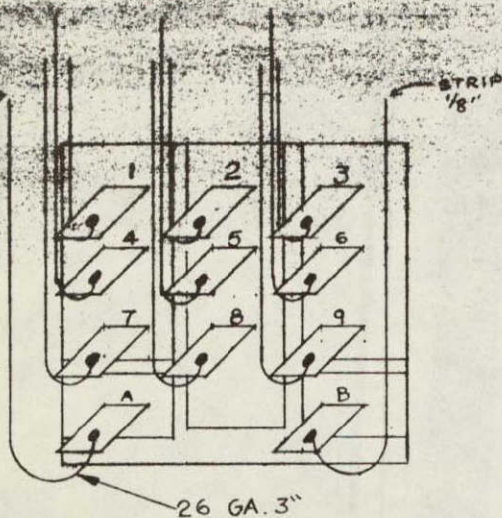
1) COVER SHEET

2) SHEETS 1 of 2  
2 of 2

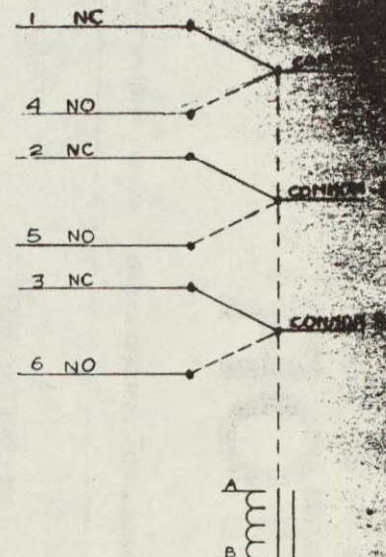
3) TITLE PAGE

ZIA ASSOCIATES INC. 76-1710T DIFFERENTIAL TEMP CONTROLLER, TEST PROCEDURE 2839 N/A COVER	D.J. D.J.
---	--------------





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# Note

For SPDT Omit 2, 3, 5, 6, 8, 9

For DPDT Omit 2, 5, 8

For 3PDT Omit No wires

16 GA. 10"

PIN	COLOR	STRIP	CNTS
1	RED	BLACK	NC
2	BROWN	"	"
3	ORG	"	"
4	RED	WHITE	NO
5	BROWN	"	"
6	ORG	"	"
7	RED	NO	COMM.
8	BROWN	"	"
9	ORG	"	"

REVISION	SHEET NO
1	1

MULTIPLE SHEETS  
REVISION STATUS

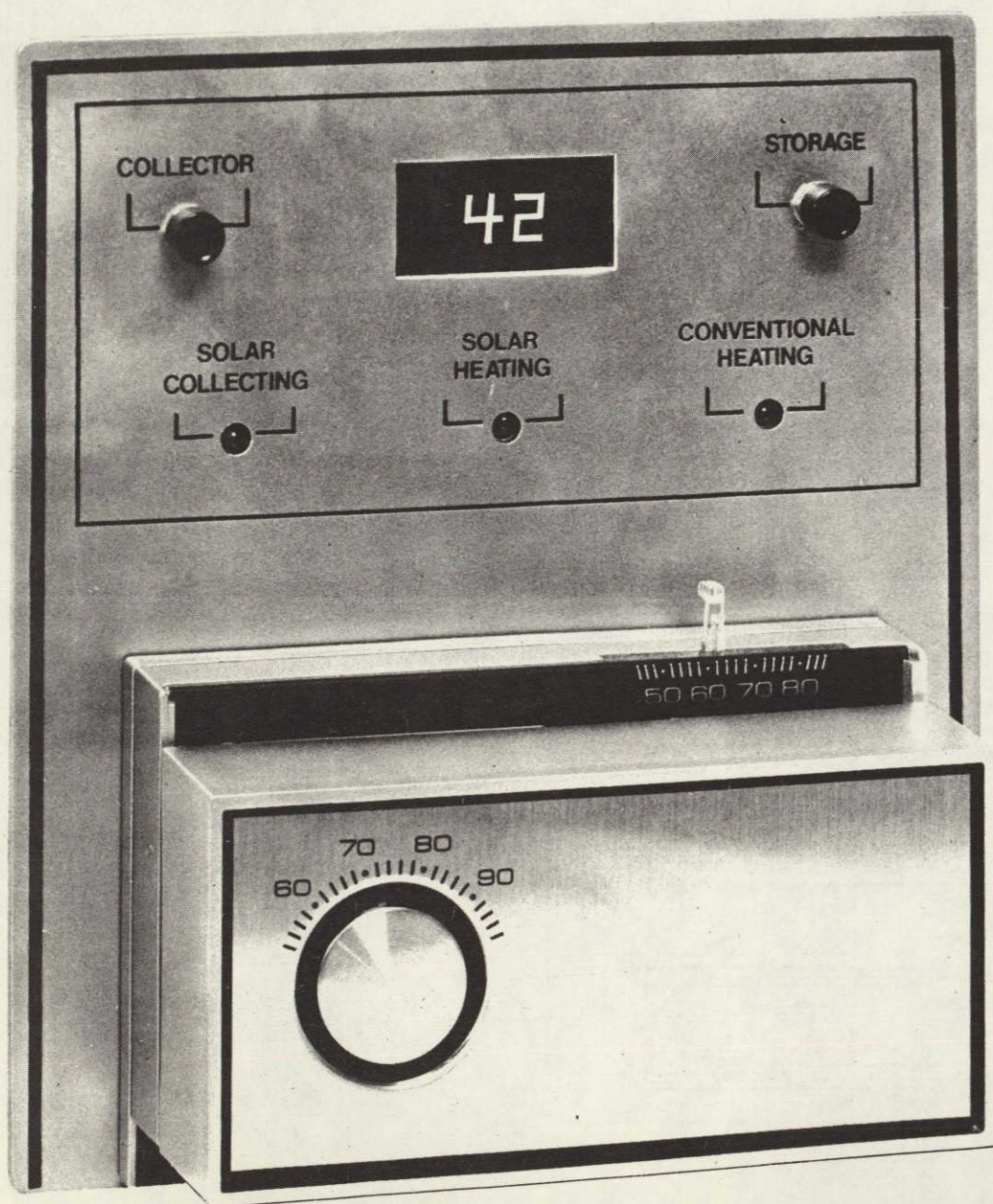
PART NO NEXT ASSY USED ON APPLICATION

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE
QTY PER ASSY				
000 DASH NUMBERED PARTS SHOWN				
PARTS LIST				
CONTRACT NO		APPROVED	DATE	<p><b>ZIA ASSOCIATES INC.</b> 171 AT Controls Relay Assembly</p>
UNLESS OTHERWISE SPECIFIED		PREP BY DOUG R.		
DIMENSIONS ARE IN INCHES TOLERANCES XX ± .02    XXX ± .010    X* ± .1"		DESIGNER		
BREAK ALL SHARP EDGES .005/.015 MIL STD 12, 15 USASI Y32 16 B46.1, Y14.5 SHOP STANDARDS 2060 THREADS PER H-28 SURFACE FINISH 125 EXCEPT AS NOTED ✓		GROUP ENG		
		CHECKED D. S.	6/4/77	
				SIZE C
				CODE IDENT NO 52060
				2886
				SCALE
				WT
				SHEET 1





# SOLARSTAT SOLID STATE SOLAR SYSTEM MONITOR



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## APPLICATION

## REVISIONS

PART NO.	NEXT ASSY.	USED ON	LTR	DESCRIPTION	DATE	APPROVED

UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES

.XX .XXX X°  
± ±.010 ±1°

CONTRACT NO.

EMC

WEIGHTS

STRESS

THERMAL

RELIABILITY

MATL &amp; PROC

GROUP ENG

DESIGNER

CHECKED

PREP BY



ZIA ASSOCIATES INC.

BOULDER

COLORADO

DRAWING BREAKDOWN,  
SOLAR-STAD (NASH)

SIZE

A

CODE IDENT NO

52060

SCALE

SHEET

1 OF 2

PREPARED BY D AUGUSTO

## DRAWING BREAKDOWN

DATE 1/21/77PROJECT Solarstat (NASA)PAGE 2NUMBER 26-937

ZE	DRAWING NUMBER	DRAWING LEVEL								DOCUMENT TITLE	EXPECTED RELEASE DATE	REMARKS
		1	2	3	4	5	6	7	8			
D	2788-A	X								TOP ASSEMBLY SOLARSTAT & FINAL PARTS LIST	2/28/77	
C	2791-A									FRONT PANEL Solarstat	2/22/77	
C	2792-D									SCHEMATIC	12/14/76	
C	2766-B									PWB SENSOR DRILL CHART	1/77	
C	2794-B									PWA SENSOR	2/28/77	
C	2765-B									PWB RETROFIT DRILL CHART	1/77	
C	2796-C									PWA	2-28-77	
A	2796&2794-FL									PARTS LIST, PVAS	1/77	
C	2797-C									SOLARSTAT DIODE PROBE	3/1/77	
C	2798-C									WIRING DIAGRAM	3/1/77	
C	2838	X								HOOK UP INSTRUCTIONS		
D	2837	X								SILNSCREEN, FRONT PANEL	4/4/77	
C	2799-B									ARTWORK, FRONT PANEL	4/4/77	AW
A	2866									TERMINAL BOARD CONNECTIONS	4/14/77	
A	2873									Test Procedure	4/12/77	
										Solarstat Heat Sink	5/18/77	
Prepared for:												
SOLAR CONTROL CORP.												
5595 ARAPAHOE ROAD												
BOULDER COLORADO												

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REVISIONS

NO.	DATE	DESCRIPTION	DATE	APPROVED

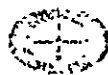
UNLESS OTHERWISE SPECIFIED  
DIMENSIONS ARE IN INCHES  
TOLERANCES

XXX .XXX .X  
010 .010 .010

CONTRACT NO

REVISION	
MATERIAL	
DESCRIPTION	
DATE	
BY	
DATE	

DATE BY *DOUG R*



ZIA ASSOCIATES INC.

BOULDER

COLORADO

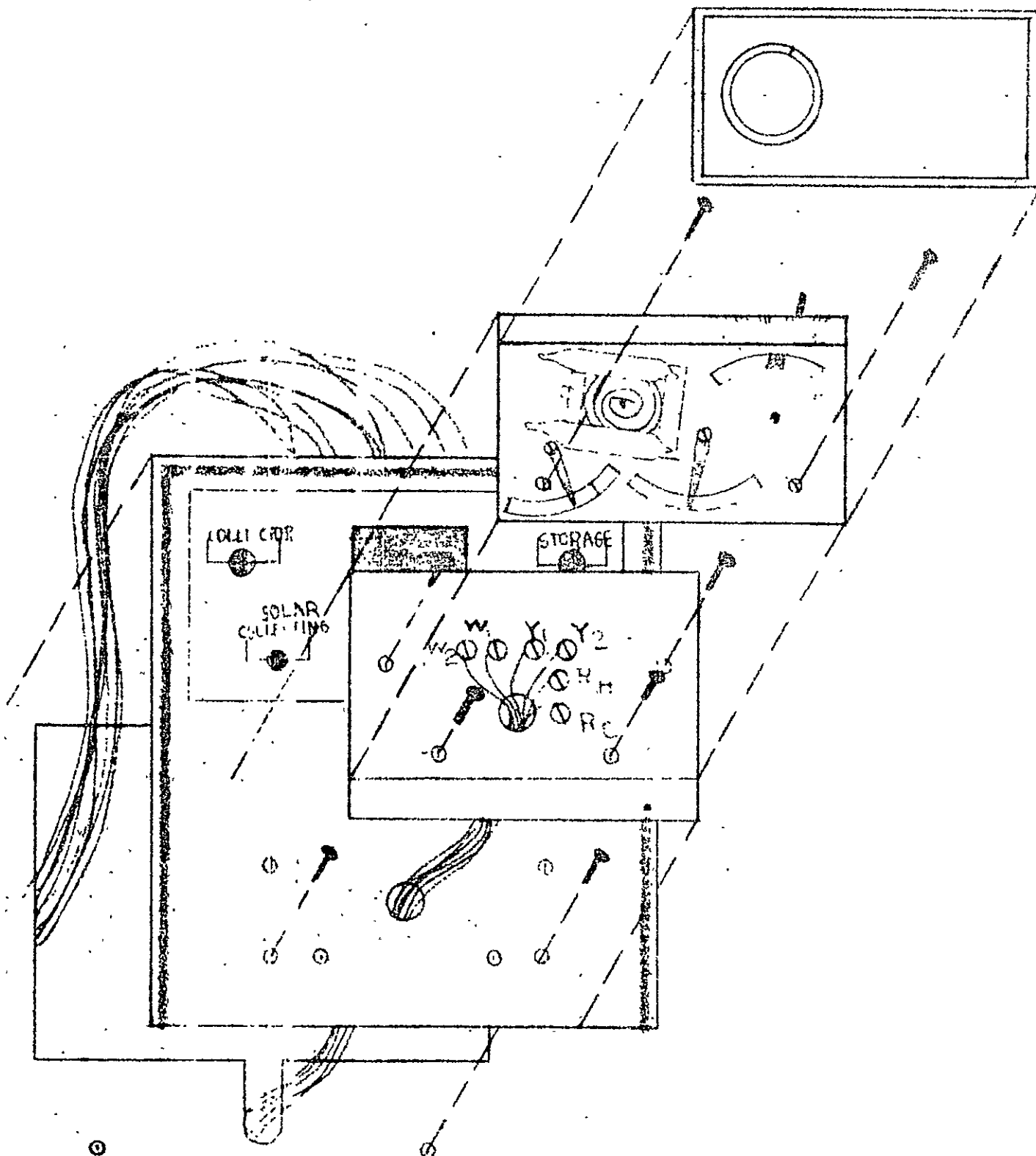
**SOLARSTAT FIELD  
INSTALLATION DIAGRAM**

DATE: 5/11/79

2594

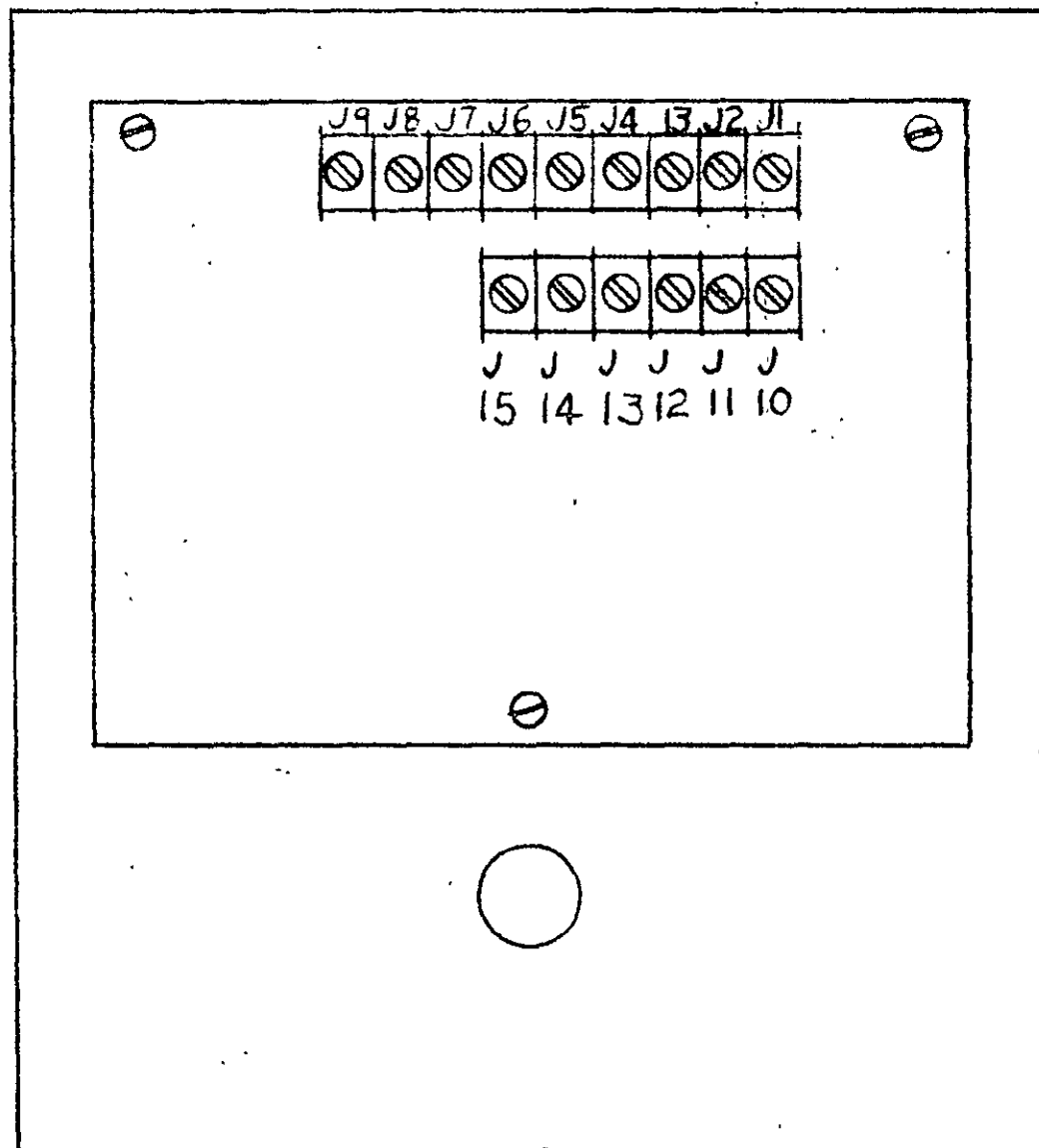
# SOLARSTAT FIELD INSTALLATION DIAGRAM

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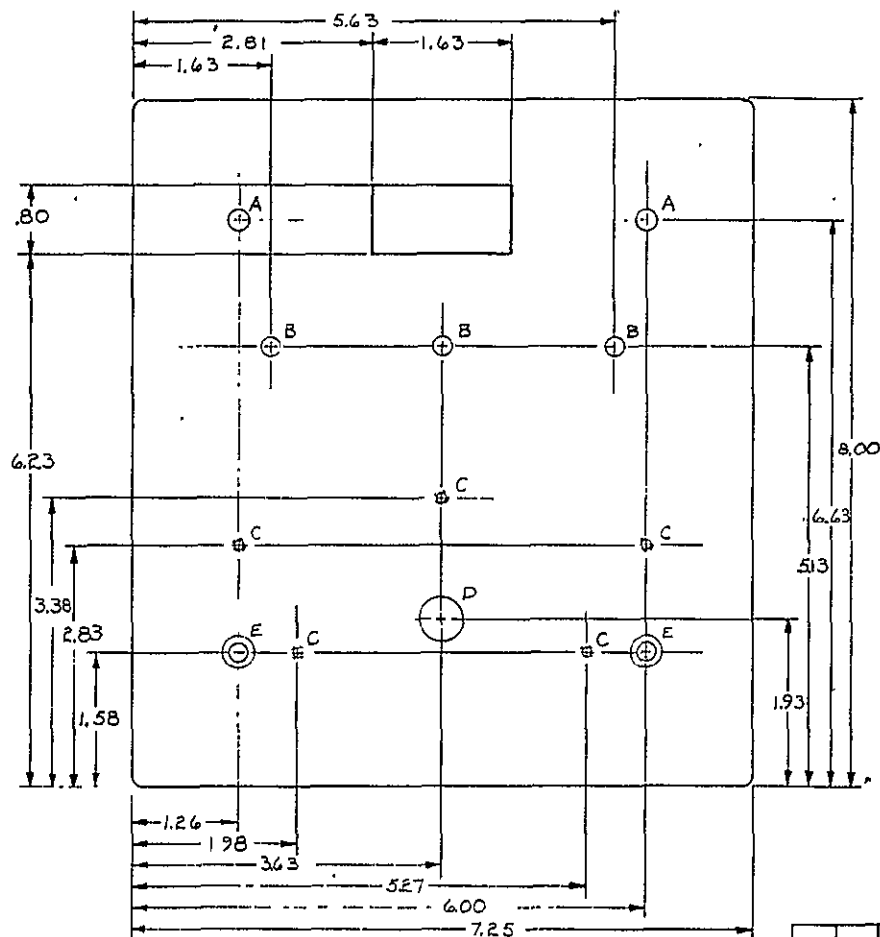
# SOLARSTAT REAR TERMINATIONS

"J" CONNECTOR	INTERFACE
J1	24 V AC
J2	24 V AC
J3	GROUND
J4	STORAGE PROBE
J5	STORAGE PROBE NEG.
J6	COLLECTOR PROBE
J7	COLLECTOR PROBE NEG.
J8	NORMAL PROBE
J9	NORMAL PROBE NEG.
J10	SOLAR COLLECTING RELAY- 24 V AC OR POS DC
J11	SOLAR COLLECTING RELAY- 24 V AC OR NEG DC
J12	SOLAR HEATING RELAY 24 V AC OR POS. DC
J13	SOLAR HEATING RELAY 24 V AC OR NEG DC.
J14	CONVENTIONAL HEATING RELAY-24VAC OR POS. DC
J15	CONVENTIONAL HEATING RELAY-24VAC OR NEG. DC



GENERAL NOTES: UNLESS OTHERWISE SPECIFIED  
1. FINISH: IRRIDITE, GOLD PAINT

REVISIONS			
LT#	DESCRIPTION	DATE	APPROVED
A	ADD NOTE 1	4/8/71	



	SIZE	QTY
A	.249 .255	2
B	.212 .218	3
C	#6-32-UNC	5
D	.50	1
E	1.56 DIA 38x45CS	2

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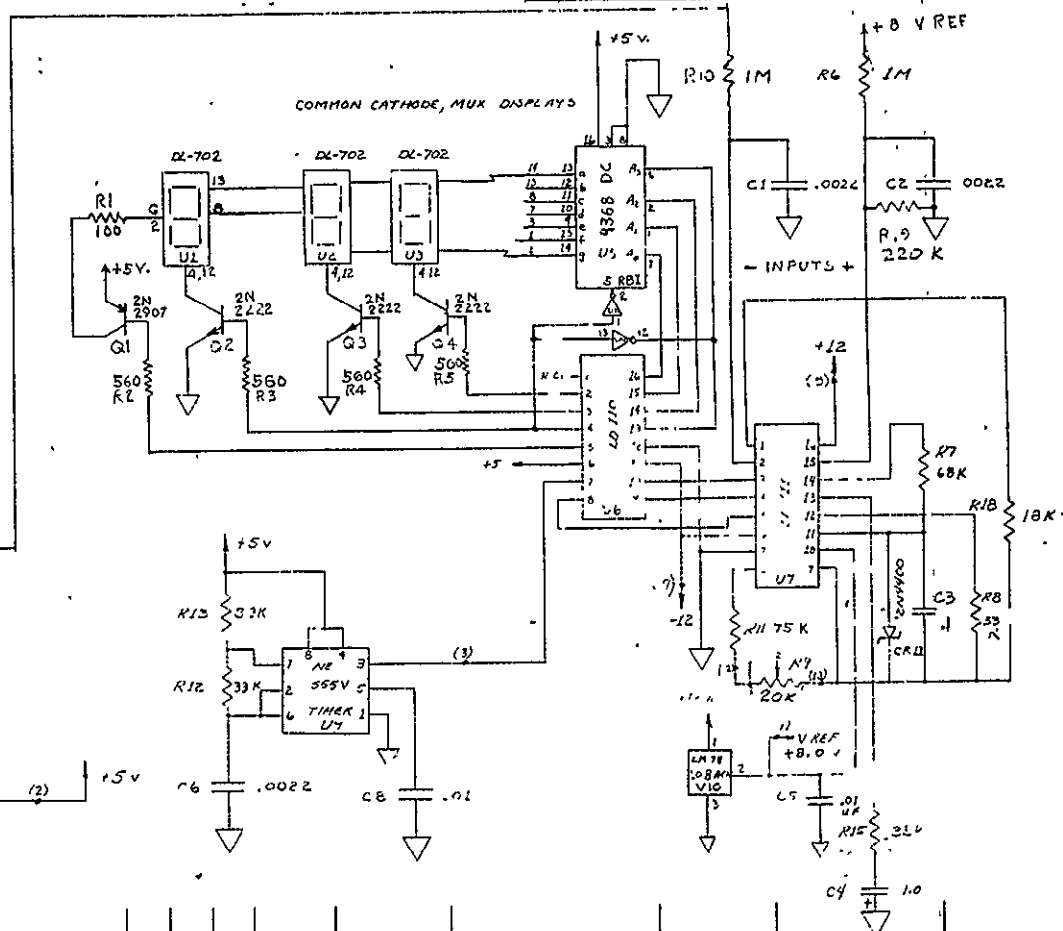
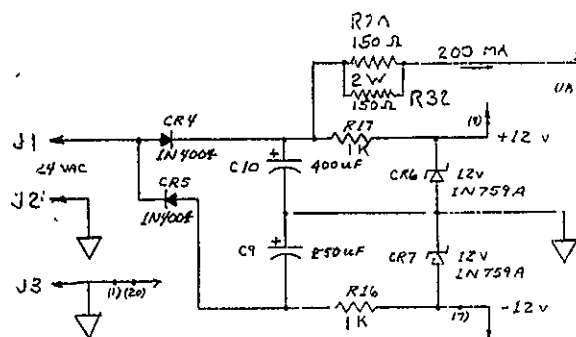
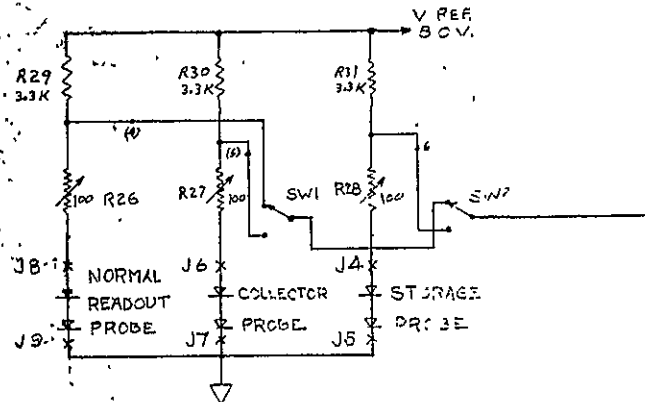
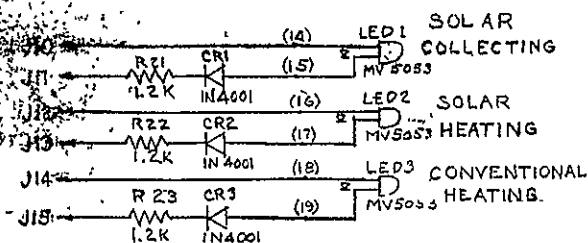
ITEM NO		CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
QTY PER ASSY		ODD DASH NUMBERED PARTS SHOWN			PARTS LIST		EVEN DASH NUMBERED PARTS OPPOSITE
CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				PREP BY	DATE	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES				DESIGNER		FRONT PANEL	
TOLERANCES				GROUP ENG		SOLAR STAT	
XX = .02				CHECKED			
XXX = .010				Prepared for:			
X* = .015				SOLAR CONTROL CORP.	SIZE	CODE IDENT NO	
BREAK ALL SHARP EDGES 005/015				5595 ARAPAHO ROAD	C	52060	2791
MIL STD 12.15				COLORADO	SCALE	1/1	WT
USAF Y32 16 R46 1 Y14 5							
SHOP STANDARDS 2040							
THREADS PER IN 20							
SURFACE FINISH 125							
EXCEPT AS NOTED							

REVISION	SHEET NO	PART NO	NEXT ASSY	USED ON	APPLICATION
1	1	2890	76-937		

MULTIPLE SHEETS  
REVISION STATUS

ALL RESISTANCE IN OHMS & CAPACITANCE IN  $\mu F$   
 2. VIO VS. 54786 HIGH VOLTAGE OUTPUT OF HEX INV  
 NUMBERS IN PARENTHESIS ARE BOARD INTERCONNECTIONS  
 TO NEAREST TERMINAL BOARD

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADDED VALUE TO R19 ADDED "SCHEMATIC" TO TITLE BLOCK	1/30/77	Self
B	R18 WAS 27K IS 18K, R40 WAS 5K IS 33K R20 WAS 2.5 IS 1.5K R21 WAS 10K IS 10K R22 WAS 10K IS 10K R23 WAS 10K IS 10K R24 WAS 10K IS 10K R25 WAS 10K IS 10K R26 WAS 10K IS 10K R27 WAS 10K IS 10K R28 WAS 10K IS 10K R29 WAS 10K IS 10K R30 WAS 10K IS 10K R31 WAS 10K IS 10K R32 WAS 10K IS 10K R33 WAS 10K IS 10K R34 WAS 10K IS 10K R35 WAS 10K IS 10K R36 WAS 10K IS 10K R37 WAS 10K IS 10K R38 WAS 10K IS 10K R39 WAS 10K IS 10K R40 WAS 5K IS 33K R41 WAS 10K IS 10K R42 WAS 10K IS 10K R43 WAS 10K IS 10K R44 WAS 10K IS 10K R45 WAS 10K IS 10K R46 WAS 10K IS 10K R47 WAS 10K IS 10K R48 WAS 10K IS 10K R49 WAS 10K IS 10K R50 WAS 10K IS 10K R51 WAS 10K IS 10K R52 WAS 10K IS 10K R53 WAS 10K IS 10K R54 WAS 10K IS 10K R55 WAS 10K IS 10K R56 WAS 10K IS 10K R57 WAS 10K IS 10K R58 WAS 10K IS 10K R59 WAS 10K IS 10K R60 WAS 10K IS 10K R61 WAS 10K IS 10K R62 WAS 10K IS 10K R63 WAS 10K IS 10K R64 WAS 10K IS 10K R65 WAS 10K IS 10K R66 WAS 10K IS 10K R67 WAS 10K IS 10K R68 WAS 10K IS 10K R69 WAS 10K IS 10K R70 WAS 10K IS 10K R71 WAS 10K IS 10K R72 WAS 10K IS 10K R73 WAS 10K IS 10K R74 WAS 10K IS 10K R75 WAS 10K IS 10K R76 WAS 10K IS 10K R77 WAS 10K IS 10K R78 WAS 10K IS 10K R79 WAS 10K IS 10K R80 WAS 10K IS 10K R81 WAS 10K IS 10K R82 WAS 10K IS 10K R83 WAS 10K IS 10K R84 WAS 10K IS 10K R85 WAS 10K IS 10K R86 WAS 10K IS 10K R87 WAS 10K IS 10K R88 WAS 10K IS 10K R89 WAS 10K IS 10K R90 WAS 10K IS 10K R91 WAS 10K IS 10K R92 WAS 10K IS 10K R93 WAS 10K IS 10K R94 WAS 10K IS 10K R95 WAS 10K IS 10K R96 WAS 10K IS 10K R97 WAS 10K IS 10K R98 WAS 10K IS 10K R99 WAS 10K IS 10K R100 WAS 10K IS 10K	1/12/77	Self



							↑ ▽	
		ITEM NO.	CODE IDENT	PART NO.	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION <small>(REFERENCE DESIGNATION LINE ONE)</small>	MATERIAL SPECIFICATION
QTY PER ASST	CDD DASH NUMBERED PARTS SHOWN				PARTS LIST		EVEN DASH NUMBERED PARTS OPPOSITE	

			CONTRACT NO		APPROVED		DATE	
			UNLESS OTHERWISE SPECIFIED		PREP BY <i>SC Potts</i>		<i>12/16/77</i>	
			DIMENSIONS ARE IN INCHES		DESIGNER			
			TOLERANCES		GROUP ENG. <i>J. SPANOLS</i>		<i>1/19/78</i>	
			$\pm .02$ $\pm .010$ $\pm .1$		CHECKED			
			BREAK ALL SHARP EDGES     005/015		P - <i>NO 1</i>			
			MIL STD 12 15					
			USASI Y32 16   846 I   Y14 5					
			SHOP STANDARDS					
			THREADS PER M 28					
			SURFACE FINISH 125					
			EXCEPT AS NOTED ✓					
PART NO			NEXT ASS Y		USED ON			
APPLICATION								

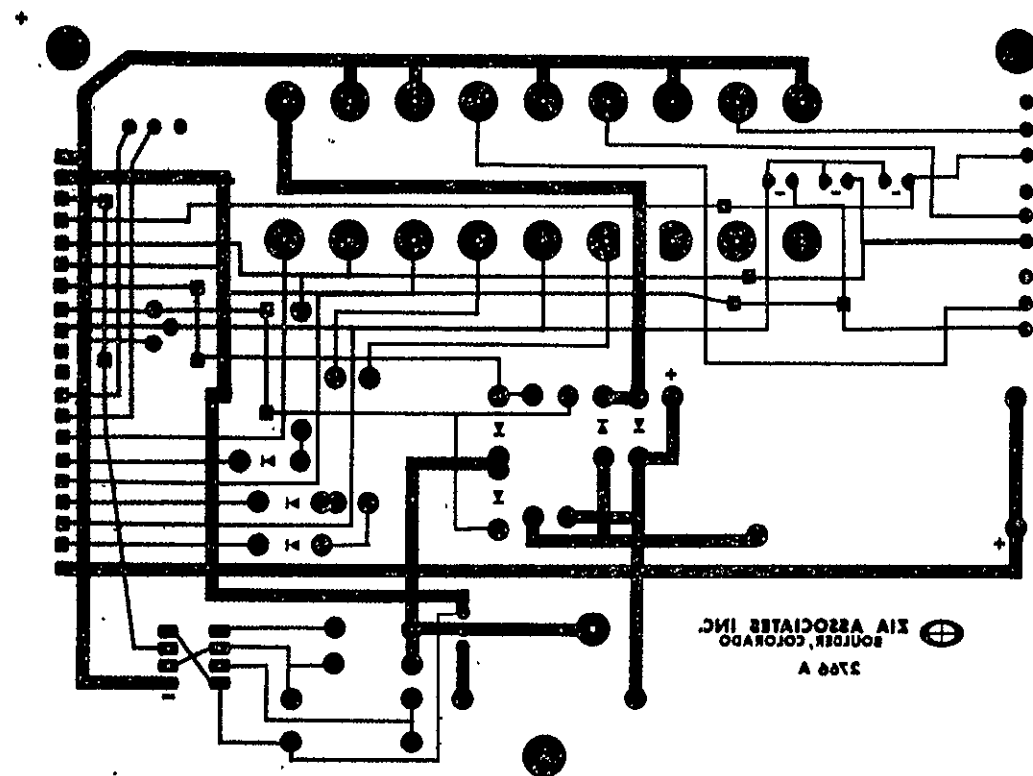
REVISED	2/1/77	1	REVISION			
		1	SHEET NO			2788
MULTIPLE SHEETS REVISION STATUS				PART NO	NEXT ASS Y	USED ON
				APPLICATION		

ZIA ASSOCIATES INC.	
BOULDER	COLORADO
SOLAR: -T DIGITAL TEMP DISPLA	
SCHEMATIC	
SIZE	CODE IDENT NO
C	52060
2772	
REV	
D	
SCALE	WT
1/4	
SHEET 1 OF 1	

GENERAL NOTES UNLESS OTHERWISE SPECIFIED

1. MATERIAL - 0.13 GLASS EPOXY 2 OZ COPPER
2. ALL HOLES PLATED THRU
3. TIN/LEAD PER MIL-STD 275

REVISIONS			
REV	DATE	BY	APP
1	10/17/64		



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ZIA ASSOCIATES INC  
BOULDER, COLORADO  
A 3075

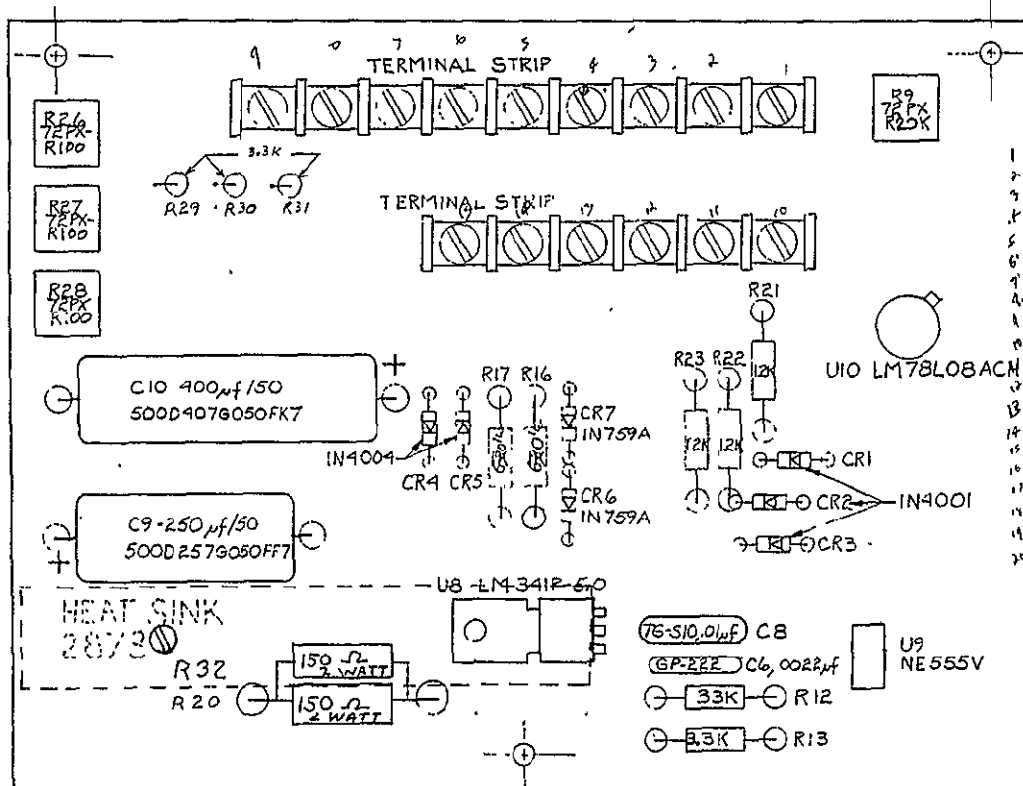
- 3 #26 18 #44 6 #65 1, #26 38 #45 8, #45 15 #65  
33 #65

ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION REFERENCE DESIGNATION ELEC DWG	MATERIAL SPECIFICATION
QTY PER ASSY	ODD DASH NUMBERED PARTS SHOWN			PARTS LIST		
CONTRACT NO			APPROVED	DATE	ZIA ASSOCIATES INC BOULDER COLORADO	
UNLESS OTHERWISE SPECIFIED			PREP BY		PWB - DP-LL-4747	
DIMENSIONS ARE IN INCHES			DESIGNER		EFN:JAN, 1964	
TOLERANCES			GROUP ENG. J. SPADWIS	3/2/64		
XX = 02 XXX 010 X* = 1*			CHECKED			
BREAK ALL SHARP EDGES 005/011			DESIGNED			
MIL STD 12 15			SIZE	C	CODE IDENT NO	52060
USASI Y32 16 846 2 Y14 5			SCALE		WT	
SHOP STANDARDS						
THREADS PER IN 28						
SURFACE FINISH 125 EXCEPT AS NOTED						
REVISION			SHEET 1 OF 1			
I SHEET NO						
PART NO						
NEXT ASSY						
USED ON						
APPLICATION						



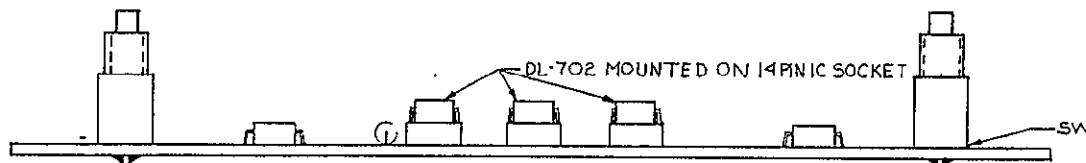
GENERAL NOTES. UNLESS OTHERWISE SPECIFIED

REVISIONS			
LT#	DESCRIPTION	DATE	APPROVED
A	CR1, CR2, CR3 REVERSED, REPOSITIONED R20 R13 WAS 3K IS 3.3K, R26, 27, 28 WAS 1K IS 100 CR8, 9, 10 DELETED. REPLACED BY R29, R30, R31 310K RESISTOR	4/2/77	JAL
B	R20 WAS 82Ω R9 WAS 10K	5/13/77	JAL
C	R16, R17 WERE 1K IS 680 1W		

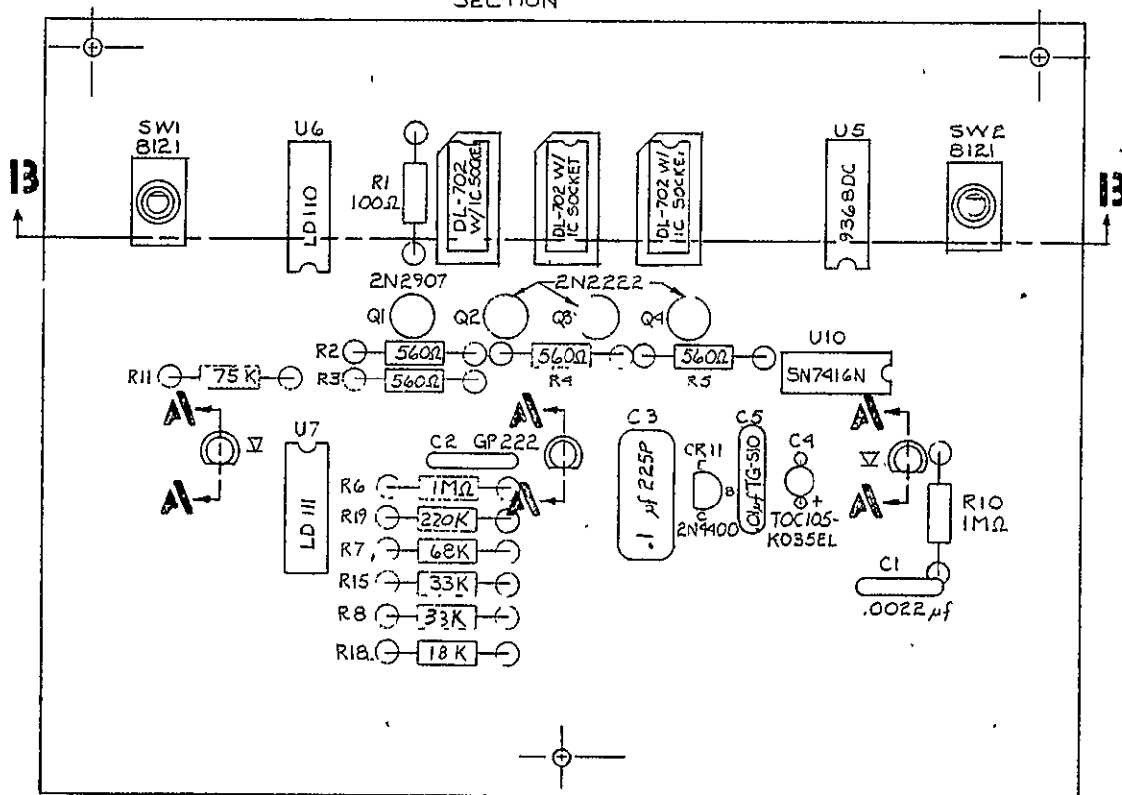


ITEM NO		CODE IDENT	PART NO	PWA	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
QTY PER ASSY		CONTRACT NO		APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED		DIMENSIONS ARE IN INCHES		DESIGNER	GROUP ENG	BOULDER COLORADO	
TOLERANCES		X.X ± 0.1		CHECKED	Prepared for:	SOLAR STAT	
BREAK ALL SHARP EDGES		005/015		SOLAR CONTROL CORP.		PWA, SENSOR	
MIL STD 12.15		USASI Y32 16 B46 1, Y14 5		5595 ARAPAHOE ROAD		2794	
SHOP STANDARDS		THREADS PER H 28		BOULDER COLORADO		SCALE 2/1 WT	
SURFACE FINISH 125		EXCEPT AS NOTED		C 52060		REV BC	
REVISION		SHEET NO 501		PART NO 2788		76937	
MULTIPLE SHEETS		REVISION STATUS		APPLICATION		SHEET 1 OF 1	

GENERAL NOTES UNLESS OTHERWISE SPECIFIED



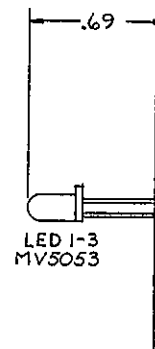
SECTION



REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	REVERSED DIRECTION OF "B" ARROWS - ADDED VALUE TO R19	3/10/77	JAL
B	REVERSED POSITION OF DL 702 THREE PLACES - R18 WAS 27K IS 18K - C3 WAS 105V6 IS 41V6	4/2/77	JAL
C	R11 WAS 100K	5/13/77	JAL

FLAT ON BOARD

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SECTION A A

ITEM NO		CODE IDENT	PART NO	PWA	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
QTY PER ASY		ODD DASH NUMBERED PARTS SHOWN		PARTS LIST			
CONTRACT NO				APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED				PREP BY	DATE	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES				DESIGNER		SOLARSTAT	
TOLERANCES				GROUP ENG		PWA READOUT	
XX .02 .015 .010				CHECKED			
BREAK ALL SHARP EDGES .005" DIA				Prepared for			
SHAFTS .125, .15				SOLAR CONTROL CORP.			
SHAFTS .125, .15, .156, .157				2796			
SHAFTS .125, .15, .156, .157				C 52060			
SHAFTS .125, .15, .156, .157				2796			
SHAFTS .125, .15, .156, .157				C			
SHAFTS .125, .15, .156, .157				C			


REVISION	SHEET NO	501	2788	76-937
MULTIPLE SHEETS				
REVISION STATUS				
PART NO	NEXT ASSY	USED ON	APPLICATION	

APPLICATION			REVISIONS			
PART NO	NEXT ASS Y	USED ON	LTR	DESCRIPTION	DATE	APPROVED
			A	ADDED DESCRIPTION TO R19	3/20/77	
			B	DELETE CR 8, CR 9, CR 10 ADD R29, R30, R31 3.3K CHANGE R20 FROM 27 $\Omega$ TO 82 $\Omega$ CHANGE R26, 27, 28 FROM 72PARK TO 72PK R100 R18 WAS 27K IS 18K R8 WAS 56K IS 33K	4/2/77	
			D	CHANGE R20 TO 150 $\Omega$ Add R32 150 $\Omega$ CHANGE R9 FROM 10K TO 20K		
			C	R11 WAS 100K IS 75K J NOS REVISED R21, 22, 23 CR1, 2, 3 PUT IN OTHER LEAD	7/26/77	

Prepared for:

**SOLAR CONTROL CORP.**

5595 ARAPAHOE ROAD  
BOULDER COLORADO

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES TOLERANCES .XX .XXX X° ± ±.010 ±1°		RELIABILITY		 <b>ZIA ASSOCIATES INC.</b> BOULDER COLORADO			
		MATL & PROC					
		GROUP ENG					
		DESIGNER					
		CHECKED					
CONTRACT NO		PREP BY	S. W.	<b>PARTS LIST</b> SOLAR STAT			
EMC							
WEIGHTS							
STRESS							
THERMAL							
		SIZE	A	CODE IDENT NO	52060	2796 & 2794 PL	REV D
		SCALE	N.A.			SHEET	1/4



ZIA ASSOCIATES INC. (SOLARSTAT)

DISPLAY

DWG. NO.

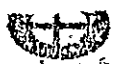
2774-2796

BOULDER COLORADO

CODE IDENT NO. 52060

SHEET 2 OF 9 REV. P

REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
RESISTOR, 1/2 WATT, 5% FIXED COMP.				
R1	100 $\Omega$	1		
ORIGINAL PAGE IS OF POOR QUALITY				
R2, R3, R4, R5	560 $\Omega$	4		
R6, R10	1 M	2		
R11	75 K	1		
R8, R15, R12	33 K	3		
R18	18 K	1		
R19	220 K	1		
R7	68 K	1		
R16, R17	1 K	2		
R21, R22, R23	1.2 K	3		
R29, R30, R31, R13	3.3 K	4		
R26, R27, R28	TRIMPOT, 100 $\Omega$ PCB MOUNT	3	Beckman	72 PX R104
R9	20 K	1	11	72 PX R10K
R20, R32	2W 5% 150 $\Omega$	2		



ZIA ASSOCIATES INC.

DWG. NO. 67-77-2176 PL

BOULDER COLORADO

CODE IDENT NO. 52060SHEET 3 of 4 REV. D

REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
CAPACITOR, DISC CERAMIC				
C1, C2, C6	.0022 $\mu$ F	3	Mallory	GP 222
C5, C8	.01 $\mu$ F	2	SPRAGUE	TG-S10
C3	.1 $\mu$ F	1	"	225P
ZIA PART NO. 2873 HEAT SINK				
P.C. card NO. 766 - B		1		
P.C. card NO. 2765 - B		1		
CAPACITOR, ELECTROLYTIC (ALUM.)				
C9	250 $\mu$ F/50V 500D	1	SPRAGUE	500D 2576 050FF2
C4	1/35 TANTALUM	1	Mallory	TOC105K035EL
C10	400/50 500D	1	SPRAGUE	500D 4076 050FFK7
LED1, LED2, LED3	MV 5053	3	MONSARTO	
CR11	ZENER	1	JEDEC	2N4400
CR1, CR2, CR3	DIODE	3	JEDEC	1N4001
CR4, CR5	RECTIFIER DIODE	2	JEDEC	1N4004
CR6, CR7	ZENER, 12VOLT	2	JEDEC	1N759A
CR8, CR9, CR10	DIODE <sup>constant current</sup>	3	SINCONIX	ES07
Q1	PNP TRANSISTOR	1	JEDEC	2N2907
Q2, Q3, Q4	NPN "	3	"	2N2222

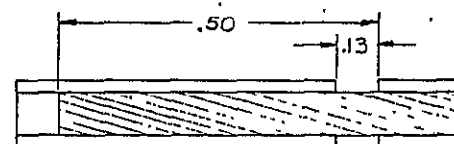
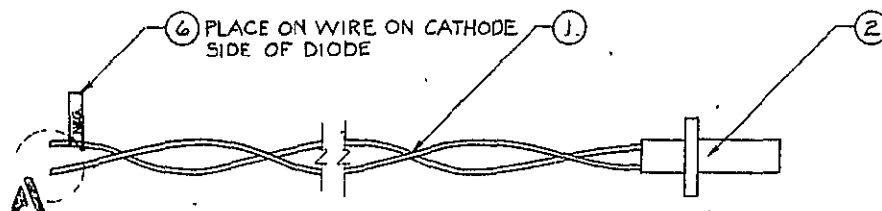
REFERENCE DESIGNATOR	DESCRIPTION	TOTAL QTY.	MFG. CODE	MFG. PART NO.
INTEGRATED CKT, DIGITAL				
	ORIGINAL PAGE IS OF POOR QUALITY			
U2, U3, Q1	7 SEG. LED DISPLAY	3	LITRONIX	DL-702
U5	BCD TO 7 SEGMENT	1	FAIRCHILD	9368 DC
U6	A/D DIGITAL CHIP	1	SILICONIX	LD110
U10	HEX BUFFER INV.	1	TI	SN7416N
INTEGRATED CKT, LINEAR				
U7	A/D ANALOG CHIP	1	SILICONIX	LD111
U8	VOLTAGE REG.	1	NATIONAL	LM 341P-5.0
U9	TIMER 555	1	SIGNETICS	NE555V
U10	VOLTAGE REG	1	NATIONAL	LM 78L08 ACN
SW1, SW2	SPDT, MOM. CONTACT	2	C&K	B121
	PWB, SENSOR	1	ZIA	2766A
	PWB, READOUT	1	ZIA	2765A
DIP 14 PIN	SOCKET	3		
Terminal Bd 9 Term	BEAU	1	Beau Vernitron	72709-50-C
Terminal Bd 6 Term	BEAU	1	Beau Vernitron	72706-50-C
FLEX CABLE	20 CONDUCTOR	1	ANSLEY	FSM-31A-20



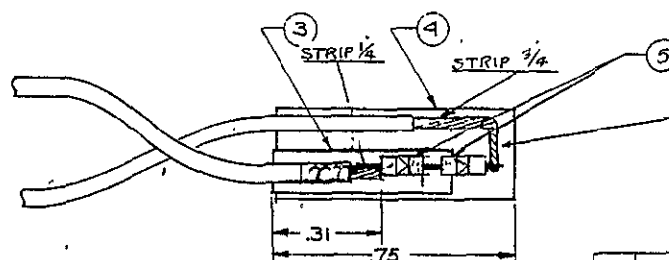
GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

- 1 IDEAL INDUSTRIES, INC., SYCAMORE, ILLINOIS.
- 2 POT DIODE ASSY. INTO HOUSING WITH CASTALL 301 RESIN. CURE WITH RT7 CATALYST FOR 24 HRS. AT 25°C.
- 3 FOR DIODE PROBES, USE GREEN TWISTED PAIR

REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED
A	ADD DESCRIPTION TO DETAIL A ADD NOTE 2.	7/14/77	SK
B	Wire Color added	4/5/79	SK
C	2-CMS 354 SIZES CHANGED SOLDER INSTRUCTIONS ADDED	4/2/77	SK



DETAIL A  
PRE-STRIP DIM. TYR



WIRING DETAIL

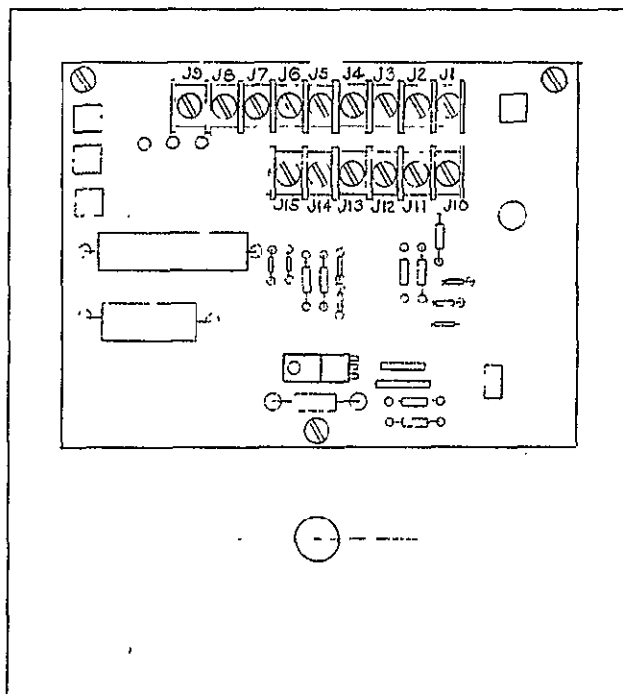
SOLDER TWO DIODES TOGETHER  
SOLDER 1/4 END TO BACK DIODE  
PLACE ITEM 3  
WRAP 1/2 TURN OF 1/4 STRIPPED WIRE ON DIODE  
WIRE. PULL TIGHT TO GLASS AND SOLDER  
TRM. ADD ITEM 4. SHRINK. POT.

1	6	43-830	NEG. WIRE LABEL		NOTE 1
2	5	IN914	SIGNAL DIODE		
1	4		HEAT SHRINK	3/2 X 3/4	
1	3		HEAT SHRINK	1/6 X 5/8	
1	2	2763-1	HOUSING		
1	1		TWISTED PAIR TEFLON INSUL WIRE	22GAX24	NOTE 3
501	ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE

CONTRACT NO		APPROVED	DATE	ZIA ASSOCIATES INC.	
UNLESS OTHERWISE SPECIFIED		DESIGNER	7/1/77	BOULDER COLORADO	
DIMENSIONS ARE IN INCHES TOLERANCES XX .02 XXX .010 X* .1"		GROUP ENG	7/19/77	SOLAR STAT	
BREAK ALL SHARP EDGES MIL STD 12, 15 USASI Y32 16 840 1, Y14 S SHOP STANDARDS 2060 THREADS PER IN 28 SURFACE FINISH 115 EXCEPT AS NOTED		CHECKED		DIODE PROBE	
REVISION		Prepared for:		SIZE CODE IDENT NO	
1 SHEET NO 501		76-937		C 52060	
MULTIPLE SHEETS REVISION STATUS		APPLICATION		2797	
PART NO NEXT ASSY USED ON		SOLAR CONTROL CORP		REV C	
		5595 ARAPAHOE ROAD BOULDER COLORADO		SCALE NONE INT	

GENERAL NOTES: UNLESS OTHERWISE SPECIFIED.

REVISIONS			
LT#	DESCRIPTION	DATE	APPROVED
A	ADD USE CODE	3/30/77	D. J.
B	NUMBERS REVISED. SPARES REMOVED 4/14/77		D. J.
C	CHANGED CONNECTORS J3,4,5,6,7,8,9	7/28/77	D. J.



"J" CONNECTOR	INTERFACE
J1	24 VAC
J2	24VAC LO
J3	GROUND
J4	STORAGE PROBE
J5	STORAGE PROBE NEG
J6	COLLECTOR PROBE
J7	COLLECTOR PROBE NEG
J8	NORMAL PROBE
J9	NORMAL PROBE NEG
J10	SOLAR COLLECTING RELAY-24VAC OR POS DC
J11	SOLAR COLLECTING RELAY-24VAC OR NEG DC
J12	SOLAR HEATING RELAY-24VAC OR POS DC
J13	SOLAR HEATING RELAY-24VAC OR NEG DC
J14	CONVENTIONAL HEATING RELAY-24VAC OR POS DC
J15	CONVENTIONAL HEATING RELAY-24VAC OR NEG DC

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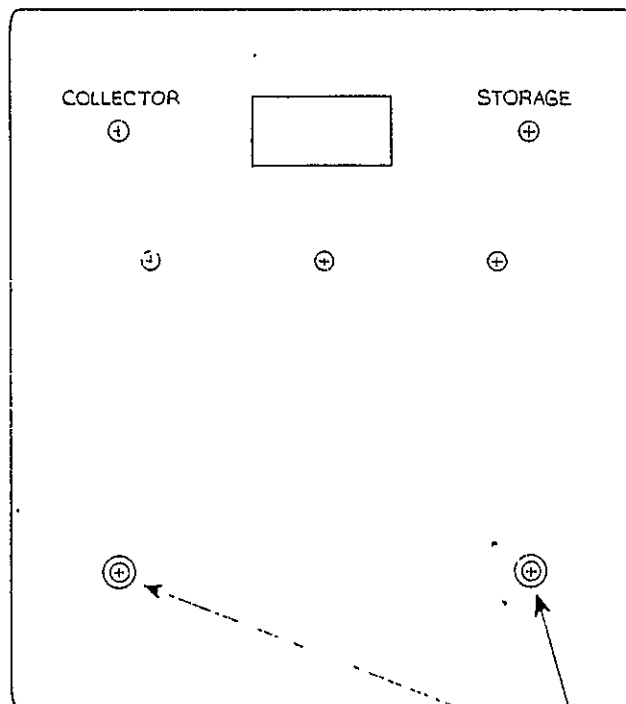
\* RECOMMENDED FOR OUTDOOR TEMPERATURE

ITEM NO.		CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	MATERIAL SPECIFICATION
QTY PER ASY		EVEN DASH NUMBERED PARTS SHOWN					
CONTRACT NO		APPROVED		DATE	ZIA ASSOCIATES INC.		
UNLESS OTHERWISE SPECIFIED		DESIGNER		DATE	BOULDER, COLORADO		
DIMENSIONS ARE IN INCHES		GROUP ENG		DATE	WIRING DIAGRAM		
TOLERANCES		CHECKED			HOOK-UP INSTRUCTIONS		
XX = .02		X* = .01					
BREAK ALL SHARP EDGES		008/015					
MIL STD 12.15							
CLASS 152 IN. 044.1, 114.5							
/BNOF STANDARDS							
THREADS PER IN 20							
SURFACE FINISH 125							
EXCEPT AS NOTED							
REVISION	SHEET NO	76-937					
MULTIPLE SHEETS		PART NO	NEXT ASSY	USED ON			
REVISION STATUS		APPLICATION					
		Prepared for:		SOLAR CONTROL CORP.			
		5595 ARAPAHOE ROAD		BOULDER, COLORADO			
		EQ/IDEX		SIZE CODE IDENT NO			
				C 52060			
				2798			
				C			


GENERAL NOTES: UNLESS OTHERWISE SPECIFIED

Artwork Number 2837

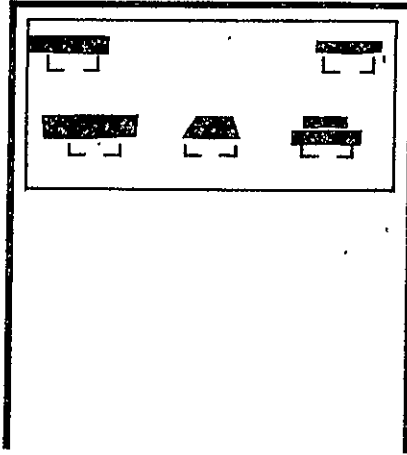
REVISIONS			
LTR	DESCRIPTION	DATE	APPROVED



Counterbore holes this side

ITEM NO		CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION MATERIAL SPECIFICATION
QTY PER ASSY		000 DASH NUMBERED PARTS SHOWN			PARTS LIST EVER DASH NUMBERED PARTS OFFSHORE	
CONTRACT NO				APPROVED	DATE	 <b>ZIA ASSOCIATES INC.</b> BOULDER COLORADO
UNLESS OTHERWISE SPECIFIED				PREP BY		
DIMENSIONS ARE IN INCHES				DESIGNER		
TOLERANCES				GROUP ENG		
3X .02 .010 .1"				CHECKED		
BREAK ALL SHARP EDGES .005/.015 MIL STD 12-15 USASI Y32 16 846 1 Y14 5 SHOP STANDARDS 2060 THREADS PER INCH SURFACE FINISH 125 EXCEPT AS NOTED						
REVISION		SHEET NO		APPLICATION		SIZE <b>C</b>
MULTIPLE SHEETS REVISION STATUS		2788 Solarstat				CODE IDENT NO <b>52060</b>
						2838
						SCALE 1/1 WT 1 SHEET 1 OF 1

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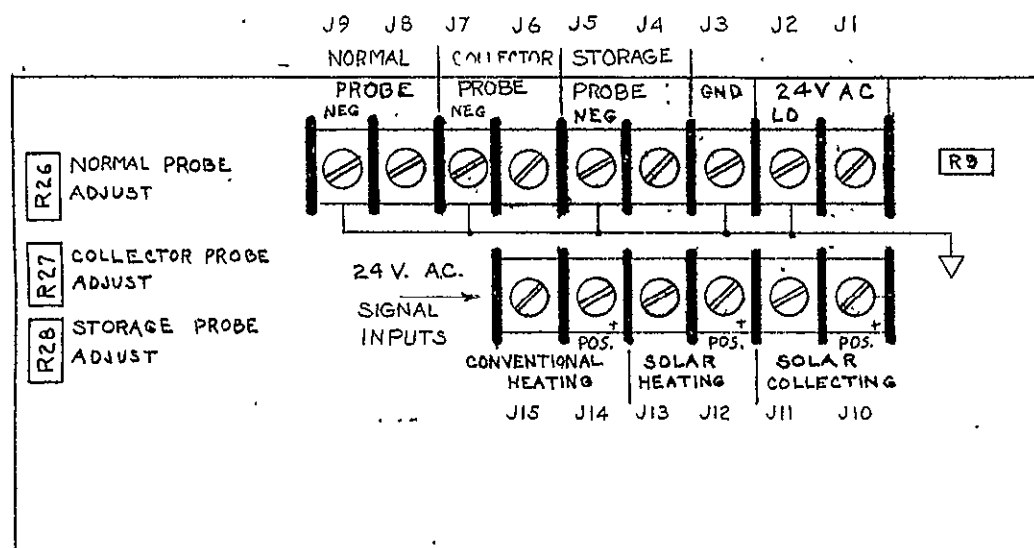
Front Panel Whitewash Silkscreen, Colorado  
5837

110 111  
5000 11  
1100 1111  
5141250000

ZIA ASSOCIATES INC	
BOULDER COLORADO	
SIZE D	CODE IDENT NO 52060
28 57	
SCALE	SHEET OF

GENERAL NOTES UNLESS OTHERWISE SPECIFIED

REVISIONS			
LTN	DESCRIPTION	DATE	APPROVED
A	NUMBERS & NAMES CHANGED	4/26/77	D.J.
B	ADDED POS ID TO J10,12,14	7/27/77	D.R.



2766A

QTY PER ASSY		ITEM NO	CODE IDENT	PART NO	NOMENCLATURE	STOCK SIZE	MATERIAL DESCRIPTION	REFERENCE SPECIFICATION FILE NO.	APPROVED FOR PURCHASE
CONTRACT NO									
UNLESS OTHERWISE SPECIFIED									
DIMENSIONS ARE IN INCHES									
TOLERANCES									
XXX ± .02 X ± .010 X ± .01									
BREAK ALL SHARP EDGES .008/.004" MAX RTO 12, 15									
USAS1 V22 16, 244.1, 174.5									
SHOP STANDARDS 9640									
THICKNESS PER H-25									
SURFACE FINISH YES									
CHECKED BY									
APPROVED									
DATE									
PREP BY									
DESIGNER									
GROUP ENG									
CHECKED									
ZIA ASSOCIATES INC									
SOLARSTAT									
TERMINAL BOARD									
CONNECTIONS									
SIZE CODE IDENT NO									
C 2766A 2766A									
DATE									

REVISION	1	SHEET NO	1
MULTIPLE SHEETS			
REVISION STATUS			
APPLICATION			



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ZIA ASSOCIATES INC.  
NASA Solarstat  
Test Procedure

D. S. 4/12/77

2866

Rev  
A

N/A

1/3

SOLARSTAT  
Test Procedure

I. Equipment Needed

- A. 3½ Digit Digital Voltmeter ( $\pm 1\%$  accuracy)
- B. 24 volt at 1 amp transformer
- C. Three dual diode temperature probes
- D. Approximately one quart ice-water bath ( $32^{\circ}\text{F}$ )
- E. Approximately one quart hot water bath ( $150^{\circ}\text{F}$ )
- F.  $0^{\circ}$  to  $200^{\circ}\text{F}$  thermometer ( $\pm 2\%$  accuracy)

II. Procedure

- A. Connect the 24 volt transformer secondary leads to the terminal block screws J1 (Hi) and J2 (ground). (Refer to Drawing Number 2799 for terminal locations.)
- B. Connect the three temperature probes to the terminal block screws J4 and J5, J6 and J7, and J8 and J9.
- C. Center the three variable resistors on the bottom printed circuit board.
- D. Connect the negative (-) (blk) Digital voltmeter lead to the negative (-) side of the 400 micro farad capacitor ( $C_{10}$ ).
- E. Connect the 24 volt transformer primary leads to a 110 volt-AC source. Allow two minutes before proceeding.
- F. Using the Digital voltmeter positive (+) (red) lead, verify the following voltages: (refer to drawing number 2794A for component location on sensor (lower) board, and 2796C for locations on the readout (upper) board)
  - a. U6 pin 8 --  $+5V \pm .20$
  - b. U6 pin 11 --  $-12V \pm 1.2V$
  - c. U7 pin 15 --  $+12V \pm 1.2V$
  - d. U7 pin 15 --  $+1.44 \pm .07V$
  - e. U7 pin 10 --  $+8V \pm .3V$

- G. Remove the Digital voltmeter connection.
- H. Place the three temperature probes and thermometer in the ice water bath. Allow five minutes before proceeding.
- I. Verify 32°F on the thermometer.
- J. While observing the LED temperature display, adjust R<sub>25</sub> for a display of 32°F.
- K. While pressing the left hand push button, adjust R<sub>27</sub> for a display of 32°F.
- L. While pressing the right hand push button, adjust R<sub>28</sub> for a display of 32°F.
- M. Transfer the three temperature probes and thermometer to the hot water bath. Allow five minutes before proceeding.
- N. Note the thermometer reading.
- O. Adjust R<sub>9</sub> for a temperature display equal to the thermometer reading.
- P. Verify the same display reading ( $\pm 1$  degree) when the left and right hand push buttons are pressed.
- Q. Repeat steps H through P until all three temperature displays match the thermometer readings for the ice water bath and hot water bath  $\pm 1$  degree.
- R. Jumper the 24V from J<sub>1</sub> and J<sub>2</sub> to J<sub>10</sub> and J<sub>11</sub>. The solar collecting LED should light. (left) Jumper J<sub>1</sub> and J<sub>2</sub> to J<sub>12</sub> and J<sub>13</sub>. The solar heating (center) LED should light. Finally, jumper J<sub>1</sub> and J<sub>2</sub> to J<sub>14</sub> and J<sub>15</sub>. The conventional heating (right) LED should light.

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